CENWW-ODG ST. JOHN 21 April, 2020

MEMORANDUM THRU:
Norman Bloom, Operations Project Manager, Little Goose Dam

FOR Chief, Operations Division
ATTN: Eric Hockersmith / Chris Peery / Ann Setter

SUBJECT: Submission of 2017 Juvenile and Adult Fish Passage Report, Little Goose Dam.

1. Enclosed find the 2017 Juvenile and Adult Fish Passage Report for Little Goose Dam as requested.

2. If you have any questions contact Scott St. John at Little Goose Dam, (509) 399-2233 ext. 263.

Scott J. St. John
Supervisory Fisheries Biologist, Little Goose Dam

Enclosure

2017 Juvenile and Adult Fish Passage Report
Little Goose Dam

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and

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Anchor QEA

April 2020

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Introduction

Little Goose Lock and Dam (LGS), located at river mile (RM) 70.3, is the third of four hydroelectric dams impounding the lower Snake River. Little Goose Dam is 2,655 feet long and impounds Lake Bryan, a 10,025-acre reservoir with normal operating elevations ranging from 633-638 feet above mean sea level (msl). Lower Monumental Dam impounds the Snake River below LGS, forming Lake Herbert G. West, creating tailwater elevations at LGS ranging from 537-544 feet msl. LGS is comprised of five major components; the powerhouse, navigation lock, earthen embankment, spillway and adult and juvenile fish passage facilities.

Adult Fish Passage

This report summarizes the operation and maintenance of the adult fish passage facility from March 01, 2017 to December 31, 2017. The Adult fishway was in service from February 21, 2017 to January 02, 2018. Fish counting activities took place from April 01 to October 31, 2017. A total of 116 fishway inspections were conducted by U.S. Army Corps of Engineers (USACE), Anchor QEA and Oregon Department of Fish and Wildlife (ODFW) biologists and technicians.

The adult fishway includes a north shore entrance and a channel under the spillway that connects to the powerhouse collection system. The powerhouse collection system has a north powerhouse entrance and a channel under the tailrace deck that connects with the fish ladder. This section also includes an adult fallback fence near the north powerhouse entrance. Ten floating orifice gates along the powerhouse channel were removed and closed off with bulkheads between 1996 and 2000. A south shore entrance also connects to the fish ladder. The ladder rises about 100’ on a 1:10 slope and exits into the forebay above the dam. Gravity provides adequate water flows for the fish ladder. For the rest of the system, however, auxiliary water is needed to attract fish into the various entrances. Auxiliary water is supplied by three turbine-driven pumps that pump water from the tailrace to the pump chamber which gravity feeds various floor diffusers in the powerhouse channel and at the bottom of the fish ladder. Additional water, gravity-fed, is provided by diverting excess water from the primary dewaterer (a juvenile fish facility component) to the pump chamber and floor diffusers.

Additionally, the fish ladder includes a fish viewing room which is not only popular for visitors, but is utilized to provide adult fish count data. Fish counting by the Normandeau Associates, under contract with the Corps, takes place from April through November.

Juvenile Fish Passage

This report summarizes activities and results associated with the collection, transportation and bypass of out-migrating juvenile steelhead *Oncorhynchus mykiss*; Chinook salmon *O. tschawytscha*; sockeye salmon *O. nerka*; and coho salmon *O. kisutch* at Little Goose Dam (LGS) in 2017. The data represented in this report was collected from April 1 through October 31, 2017 by USACE, Anchor QEA and ODFW Smolt Monitoring Program (SMP) and transportation biologists and technicians.

The juvenile fish collection and bypass system at LGS extends from the upstream face of the dam downstream to the Juvenile Fish Facility (JFF) and tailwater area. System components include 18 extended length submersible bar screens (ESBS), 18 vertical barrier screens (VBS), 36 gatewell orifices, a collection channel, a dewatering structure, and a corrugated flume, which

routes fish diverted from the forebay to the JFF. The JFF consists of a fish separator, routing flumes, fish holding raceways, a sampling and marking laboratory, truck and barge loading facilities, and a passive integrated transponder (PIT) tag detection and diversion system.

The objective of the transport program is to improve survival of out-migrating smolts, resulting in increased adult salmon and steelhead returns. Operating parameters are set forth annually in the Fish Passage Plan (FPP) and Fish Operations Plan (FOP).

River Conditions

River Flows

Above-average winter and spring precipitation preceded a high flow summer. As a result, flows were 167.0% of the 5-year average. During the 2017 fish passage season, April 1 through November 2, the average daily flow was 74.8 thousand cubic feet per second (kcfs). The maximum average daily flow of 180.7 kcfs occurred on May 13 and the minimum average daily flow of 14.2 kcfs occurred on October 13 (Figure 1). Monthly flows were above the 5-year average for all months.

Table 1. Comparisons of average monthly flow and spill in kcfs at Little Goose Dam JFF 2012-2017.

Month	2012	2013	2014	2015	2016	2017	2012 to 2016 Average
				Flows (kcfs)			
Apr	113.60	56.68	74.33	48.27	87.05	132.84	75.99
May	102.07	79.99	99.66	59.08	87.36	139.59	85.63
Jun	87.38	55.41	84.92	41.34	52.30	127.97	64.27
Jul	46.35	33.44	45.53	27.69	32.11	50.02	37.02
Aug	28.38	23.16	26.87	20.91	23.70	29.96	24.60
Sep	21.09	18.37	19.93	17.96	18.90	25.79	19.25
Oct	18.09	21.75	17.55	15.53	20.74	22.81	18.73
				Spill (kcfs)			
Apr	36.99	16.30	22.37	12.84	24.70	43.41	22.64
May	32.28	24.75	29.34	17.68	25.77	76.33	25.64
Jun	31.86	16.62	24.95	12.74	15.68	50.41	20.37
Jul	17.89	10.57	13.97	9.11	10.42	14.94	12.39
Aug	9.52	7.64	8.73	6.98	8.51	10.34	8.28
Sep	0.18	0.50	0.17	0.13	0.18	0.21	0.23
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00

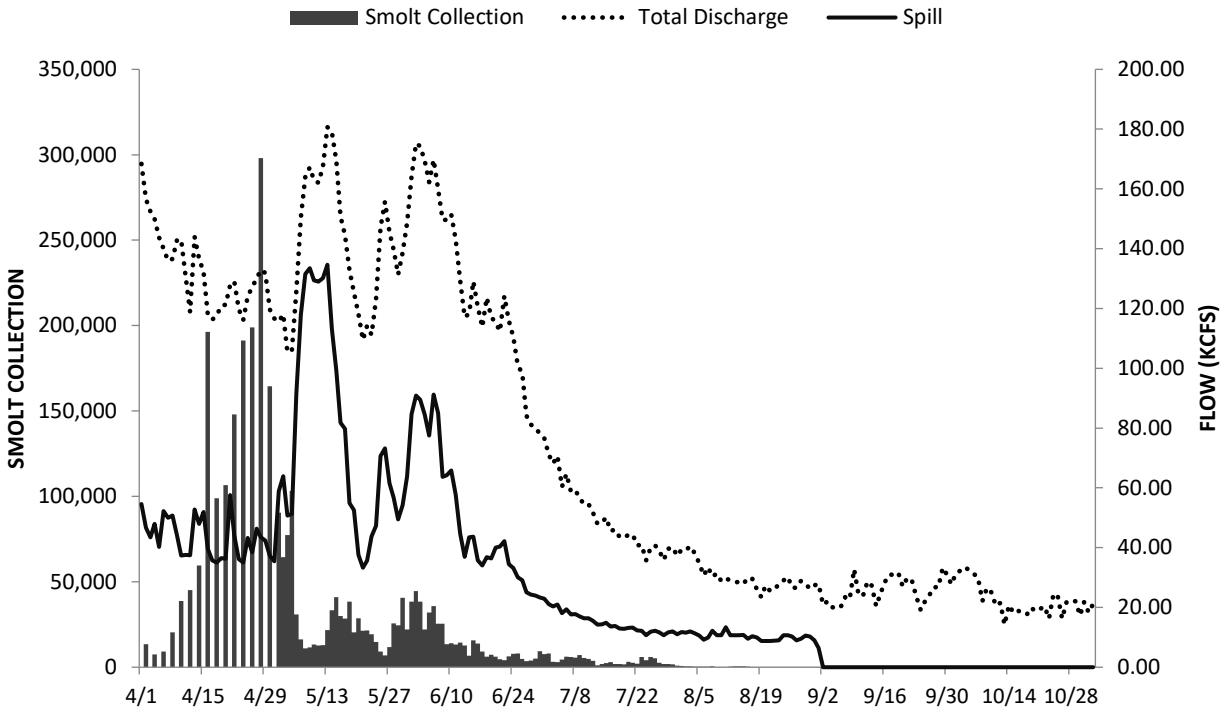

Figure 1. Total river flow, spill, and number of juvenile salmonids collected at Little Goose Dam during the fish collection and transport season, 2017.

Spill to aid juvenile fish passage occurred from April 3 through August 31, 2017, in accordance with the 2017 FPP. The spill target of 30% of total flow was maintained during that interval except for April 3, 10 and 11. Flow decreased to below 32 kcfs August 8, and, in accordance with the FPP, spill was changed to a constant rate of between 7 and 11 kcfs, whichever more closely provided the target spill rate of 30% of the total flow. The Temporary Spillway Weir (TSW) was installed into spillbay 1 on April 3 and removed on July 20 due to high river temperatures.

To enhance fish migration and in compliance with the 2017 supplemental Federal Columbia River Power System Biological Opinion, Minimum Operating Pool (MOP) elevations were placed into effect during the spill to aid fish passage. Forebay elevations were increased from MOP elevations (633 to 634 feet MSL) to MOP +2 (634 to 636 feet MSL) after September 1, 2017, when spill to aid fish passage ended. All deviations from the FPP were coordinated through the Technical Management Team or FPOM, as necessary, to meet real-time operational requirements.

River Temperature

The average daily river temperature during the 2017 fish passage season was 61.1 °F. Average monthly water temperatures were within 1.1 °F of the 5-year average for every month except September which was 2.5 °F warmer than the 5-year average. The maximum river temperature of 70.3 °F was recorded on August 6 and was slightly above the 5-year average

maximum of 69.4 °F. The 2017 minimum river temperature of 46.7 °F was recorded April 3, and was above the 5-year average minimum of 45.0 °F.

As per the Water Management Plan, river temperatures were tempered by scheduled cool-water releases from Dworshak Reservoir. Supplemental flow from Dworshak Reservoir started June 20 averaging 7.6 kcfs at 46.0 °F for that period of June, 10.4 kcfs at 44.2 °F for the month of July, 9.7 kcfs at 46.2 °F for the month of August, and 5.3 kcfs at 49.4 °F for the month of September (sourced from Columbia River Data Access in Real Time [DART]). Temperatures recorded daily in the LGS JFF averaged 68.4 °F in July, 69.0 °F in August, and 68.1 °F in September.

Total Dissolved Gas

Total dissolved gas (TDG) data are automatically collected and transmitted hourly to the Columbia River Operational and Hydromet Management System to provide information for spill and gas saturation management. TDG was monitored in the forebay from March 14 through September 13, 2017, and year-round in the tailwater.

The USACE Reservoir Control Center coordinates efforts to maintain TDG saturation levels in accordance with the Washington State TDG Level Variance Standard of 120.0% saturation in the project tailwater and 115.0% in the forebay of the next project downstream, as measured throughout 12 consecutive hours.

The average daily TDG level in the LGS forebay, from April 3 through September 13, 2017, was 112.0% saturation. TDG saturation ranged from 102.2% on September 13 to 123.3% on June 7. From April 3 to June 12, there were 55 days in which TDG saturation levels exceeded 115.0% in the LGS forebay, with an average of 117.4%.

In 2017, the TDG level in the LGS tailrace ranged between 90.6% on September 21 to 129.9% on May 12, averaging 115.6% during the spill to aid fish passage season (April 3 through August 31). Tailwater TDG levels exceeded 120.0% saturation 35 days between April 5 and June 10, averaging 121.2%.

Forebay TDG levels at LMN ranged from 101.4% on September 10 to 132.2% on May 9, averaging 114.5% from April 3 through September 13. The LMN forebay TDG levels exceeded 115.0% 80 days between April 3 and June 26, with an average of 121.2% (USACE via Columbia River DART). The spike in days exceeding TDG Level Variance Standard was due to the high flow year experienced in 2017.

Turbidity

Water clarity was measured during adult fish passage facility inspections. Measurements were taken in the adult fish ladder using a Secchi disc lowered to a maximum depth of 6 feet. The fish ladder water supply is gravity fed from the forebay and is representative of river conditions. The highest turbidity was recorded during periods of high outflow from April 1 through May 31, 2017, with Secchi measurements ranging between 1.2 and 2.6 feet and averaging 2.2 feet. Turbidity was lowest during periods of low flow, from July 2 through November 2, with Secchi measurements ranging from 3.4 feet to 6.0 feet and averaging 5.2 feet.

Adult Fish Facility

Facility Description

The adult fish facility is located on the downstream side of the dam and functions to attract and pass adult migrating fish upstream over the dam. The facility consists of a fish ladder and a collection channel. The collection channel acts to attract and route fish from across the tailrace to the fish ladder. Components of the collection channel system include two South Shore Entrances (SSE), two North Powerhouse Entrances (NPE), two North Shore Entrances (NSE), the collection channel itself, a fallout fence, an auxiliary water supply system, and an electronic monitoring and control system.

The pool-and-weir fish passage ladder is located on the south shore. It is approximately 1,000 feet long and rises a vertical distance of about 100 feet. The ladder begins at the junction pool near the SSE and leads upstream westward approximately 400 feet and switches back with a curve south and then east. It continues another 550 feet to the east where it passes under the dam's intake deck and exits into the forebay.

The viewing room and fish counting windows are located approximately 300 feet from the start of the ladder at the junction pool. The fish counting slot is fixed at a width of no less than 18" deep by 36" high by 48" wide. Underwater vertical fences called "Picketed Leads" guide and confine fish to pass through the counting slot.

The two SSE (SSE1 and 2) have overflow weirs that are normally open. The two NPE (NPE1 and 2) have overflow weirs and are normally open. NPE3, a lift gate entrance, was permanently closed with a concrete bulkhead in February 2011. The two north shore entrances (NSE1 and 2) are also overflow weirs and were normally open. NSE3, a lift gate entrance, was also permanently closed with a concrete bulkhead in 2011.

Additionally, ten floating orifice gates located in front of the powerhouse have been removed and permanently sealed with bulkheads. Floating orifice gates 1, 4, 6, and 10 have been closed since the 2000 fish passage season and floating orifice gates 2, 3, 5, 7, 8, and 9 have been closed since January 1996. Research has shown that adult fish attraction into the adult fish channel improved with these gates closed.

The adult collection channel begins at the NSE, passes under the spillway, past the NPE and fallout fence then continues along the base of the powerhouse, and terminates in the junction pool near the base of the ladder. A separate short channel connects the SSE to the junction pool and ladder. The fallout fence, consisting of a steel tube framework and wire mesh panels, is located in the channel near NPE1 and 2. It functions to prevent fish in the channel from leaving the channel and re-entering the tailrace via NPE.

The collection channel water is supplied from three sources. First, the fish ladder coupled with a diffuser (diffuser 13) supplies approximately 75 cfs of water and flows via gravity into the channel. Second, three turbine-driven pumps (fish pumps) supply approximately 1,700-2,000 cfs of auxiliary water. The fish pumps move water from the tailrace into a head channel for which gravity forces water through 21 sluice gates and up through 20 diffusers located on the floor of the collection channel in front of the powerhouse, near the junction pool and lower end of the ladder. Third, 175-230 cfs of excess water from the primary dewater unit of

the juvenile fish collection system also flows into the head channel and up through the floor diffusers.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each of the 6 entrance weirs.

An electronic water velocity meter (flow meter) was added to the collection channel near the SSE in November 1997. The meter was programmed to measure subsurface water velocities near the junction pool and diffuser 2. Diffuser 2 (the largest of the water supplying diffusers) produced upwelling and non-laminar flows making measurements unreliable. The flow meter failed in spring of 2011 and was replaced with a hydrologic current meter. In 2017, subsurface water flow velocities were measured near the NPE approximately midpoint of collection channel where flows are more representative of the entire collection channel.

Adult Fish Passage and Fishway Activities

Research and Monitoring Activities

In 2017 a total of 156,429 salmonids were visually counted passing upstream through the adult fish ladder. The species counts were: 60,789 Chinook adults; 16,282 Chinook jacks; 59,259 steelhead; 288 sockeye; 6,810 coho adults and 1,081 coho jacks. Additionally, 472 adult lamprey were counted migrating upstream at the adult fish counting window.

Several monitoring activities involving the use of the adult fishway were in progress in 2017. These included:

- Normandeau Associates Inc. conducted visual fish counting activities from 0400 hours to 2000 hours April 1 – October 31[1].

- Water temperature within the adult ladder was recorded on an hourly basis in an ongoing trend study in support of safe fish passage.

- Invasive species were monitored with particular attention to zebra and quagga mussels. Reports were submitted weekly to District biologists.

Operations and Maintenance

The Adult fishway was in service from February 21, 2017 to January 02, 2018. Adult fishway inspections were conducted three times per week by U.S. Army Corps of Engineers, Anchor QEA and Oregon Department of Fish and Wildlife biologists and technicians. The in-water maintenance period occurred from January 2 to February 20, 2017.

The fish ladder functioned adequately throughout the season. The air bubbler located at the ladder exit to push back debris performed well all season. Diffuser 13 functioned without incident and water level over the weirs were maintained within criteria. Picketed leads remained clear of debris and the counting window backboard was routinely cleaned throughout the season.

[1] 0500 to 2100 Hours during daylight savings time. No nighttime counts are made at Little Goose Dam.

Water clarity and temperature were measured during adult fish passage facility inspections near the fish counting window area. Water clarity was measured using a Secchi disc that was lowered to a maximum depth of just over 6 feet (see River Conditions).

The packing material in expansion joints in the fishway has decomposed over the years and when water temperatures fall below 50°F, the ladder contracts and water leaks through these joints. When temperatures drop below freezing, large icicles form overhead and large patches of ice form on the ground below. Both are hazards to safe working conditions.

An electronic computer interface system for operating and monitoring the adult fishway was put in service in March 1994. The original Fishway System Control (FSC) includes water elevation sensors for the fishway channel and tailrace near each entrance and elevation sensors and controls for each entrance weir (6). The FSC system that monitors and controls the fishway failed in March, 2012. A new control panel and updated software were installed during the winter of 2015. The updated software was placed into service for 2016, however the system failed to maintain fishway criteria and was placed back into manual mode.

The Rickly hydrologic current meter was again used in 2017 to determine subsurface velocities in the adult collection channel. Measurements were taken monthly just downstream of the NPE before the channel enters under the spillway, approximately mid-point of the length of the channel. This position best measures laminar flows that represent the overall flow rates of the channel. Subsurface velocities were measured just below the surface, at mid-depth, and just above bottom and averaged. The subsurface velocities were measured once per month and submitted in weekly reports. Collection channel surface water velocities were measured using a floating stick or bubble that was timed over a distance and calculated into feet per second. Measurements ranged from 1.2 to 3.2 feet per second (fps) near the NPE's and 1.4 to 3.2 fps near the NSE's.

Auxiliary water supply (AWS) system operated with three fish pumps for 2017. Fish pump 2 tripped offline on March 2 and intermittently operated from March 3 through March 7.

The adult fishway was removed from service on January 2, 2017 when the ladder was dewatered. Fish ladder maintenance included repairing expansion joints, inspecting weirs, removing debris, cleaning the picketed leads, cleaning lamp lenses, cleaning viewing windows and installing an automatic fish window cleaning system. Collection channel maintenance included inspecting diffuser grating and supporting beams, removing debris and repairing the fallback fence from the powerhouse section of the adult channel. Sluice gates that function to pass auxiliary supply water to the fish channel are in poor or non-operating condition. These gates are adjusted to position using a mobile electric operator. Many of the sluice gate indicator rods are bent and need replacing/repair. These gates and indicators need to be operational working condition to adjust correct gate position to provide the optimum water supply and flow criteria for adult fish passage.

Adult Fishway Inspections

Adult fishway inspections during the 2017 fish passage season were conducted by USACE, Anchor QEA and ODFW biologists and technicians. Inspections by the ODFW were done once a month from April through October, generally on designated days. Inspections by USACE and Anchor QEA were conducted three times a week from March through December. Problems observed during an inspection were reported to the Project Biologist and/or the Dam

Operator for appropriate action. Adult fishway criteria are detailed below in the results section. All inspection data were entered into a computer spreadsheet that provided an indication as to whether operating criteria were met.

Inspection Results

The adult fish ladder section of the adult fishway includes differentials at the ladder exit, ladder weirs and counting station. The ladder weirs and counting station met criteria throughout the entire season and the ladder exit was found out of criteria on one inspection (Table 2). The ladder exit trash rack and picketed leads remained relatively clean throughout the season. The air bubbler at the ladder exit was in service during the season and kept debris from collecting in front of exit area.

The collection channel continued to have mechanical and electrical problems but for the most part performed adequately throughout the season. Channel to tailwater elevation criteria was met 95.7% or better at all locations throughout the season. Weir depth criteria was met at least 91.4% of the time at NSE, 49.1% of the time at NPE and 93.1% of the time at SSE. NPE weirs were on sill for at least 48.3% of all inspections (Table 2). Low tailwater elevations will cause NPE weirs to bottom-out on its sill elevation at 532 feet.

Surface water velocities measured near the NPE and near the NSE met criteria (1.5 – 4.0 fps) 97.4% and 99.1% respectively (Tables 2 and 3). Surface velocities near the South junction pool were not measured in 2017. As mentioned earlier, upwelling from diffuser 2 interferes with laminar flows near the South shore junction pool.

Table 2. Summary of adult fishway inspections at Little Goose Dam, 2017. [1]

LITTLE GOOSE	No. in		Not Enough Depth				Too Much Depth		
Criteria and	Criteria/	% In	No./%	No./%	No./%	No./%	No./%	No./%	No./%
Locations	No. on Sill/	Criteria/	Weir Raised	Within	Within	>0.2	Within	Within	>0.2
	No. of	% On	Or Closed	0.01-0.1	0.11-0.2	Foot	0.01-0.1	0.11-0.2	Foot
	Inspections	Sill		Foot	Foot		Foot	Foot	
Channel Velocities (NPE)	113	97.4	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	116								
Channel Velocities (NSE)	114	99.1	***	***	***	***	***	***	***
	***	***	***	***	***	***	***	***	***
	115								
Differentials									
Ladder Exit	115	99.1	***	***	***	***	0	0	1
	***	***	***	***	***	***	0.0	0.0	0.9
	116								
Ladder Weirs	116	100.0	***	0	0	0	0	0	0
	***	***	***	0.0	0.0	0.0	0.0	0.0	0.0
	116								
Counting Station	116	100.0	***	***	***	***	0	0	0
	***	***	***	***	***	***	0.0	0.0	0.0
	116								
South Shore	113	97.4	***	1	1	1	0	0	0
	***	***	***	0.9	0.9	0.9	0.0	0.0	0.0
	116								
North Powerhouse	113	97.4	***	0	0	0	0	1	2
	***	***	***	0.0	0.0	0.0	0.0	0.9	1.7
	116								
North Shore	111	95.7	***	2	0	1	0	0	2
	***	***	***	1.7	0.0	0.9	0.0	0.0	1.7
	116								

Weir Depths									
SSE-1	112	96.6	0	0	1	3	***	***	***
On Sill[2]	0	0.0	0.0	0.0	0.9	2.6	***	***	***
	116								
SSE-2	108	93.1	0	0	3	3	***	***	***
On Sill[2]	2	1.7	0.0	0.0	2.6	2.6	***	***	***
	116								
NPE-1	60	51.7	0	0	0	0	***	***	***
On Sill[2]	56	48.3	0.0	0.0	0.0	0.0	***	***	***
	116								
NPE-2	57	49.1	0	0	0	0	***	***	***
On Sill[2]	59	50.9	0.0	0.0	0.0	0.0	***	***	***
	116								
NSE-1	107	92.2	0	2	1	6	***	***	***
On Sill[2]	0	0.0	0.0	1.7	0.9	5.2	***	***	***
	116								
NSE-2	106	91.4	0	3	0	7	***	***	***
On Sill[2]	0	0.0	0.0	2.6	0.0	6.0	***	***	***
	116								

[1] Data are from Appendix 1.
[2] "On sill" means the weir gate was bottomed out on its sill and within criteria at this location.

Table 3. LGS collection channel in-criteria rates 2013-2017.[1]

Location	**Collection Channel Success Rates - Annual Comparison**				
	2013	2014	2015	2016	2017
Channel Surface Water Velocities					
South Shore Entrance (SSE)	67.3%	84.1%	N/A	N/A	N/A
North Powerhouse Entrance (NPE)			99.1%	96.8%	97.4%
North Shore Entrance (NSE)	100.0%	98.3%	99.1%	95.7%	99.1%
Channel Head Differentials					
SSE	96.1%	100.0%	96.6%	93.7%	97.4%
NPE	89.8%	99.2%	94.8%	92.1%	97.4%
NSE	86.7%	96.6%	84.5%	93.7%	95.7%
Channel Weir Depths					
SSE1	100.0%	98.4%	90.5%	89.7%	96.6%
SSE2	98.4%	93.6%	87.9%	84.9%	93.1%
NPE1 without on-sill criteria	27.8%	37.1%	9.5%	38.1%	51.7%
NPE1 with on-sill criteria	100%	96.0%	19.0%	87.3%	100%
Location	**Collection Channel Success Rates - Annual Comparison**				
	2013	2014	2015	2016	2017
NPE2 without on-sill criteria	25.4%	38.7%	9.5%	33.3%	49.1%
NPE2 with on-sill criteria	34.1%	96.0%	19.8%	90.5%	100%
NSE1	47.3%	65.0%	88.8%	46.0%	92.2%
NSE2	47.3%	65.0%	88.8%	45.2%	91.4%

[1] Data compiled from Appendix 1, previous monitoring report appendixes and inspection forms for the years 2013-2017.

Average tailrace elevations in 2017 were slightly higher than the 5-year average at all locations (Table 4). To enhance fish migration, reservoirs were drafted down to minimum operating pool (MOP) elevations from April through August. During MOP, Lake Herbert G. West was operated between 537.0 and 538.0 as measured at Lower Monumental Dam.

During inspections, tailrace water elevations were simultaneously collected at the FSC for the SSE, NPE and NSE locations. These readings usually varied from 0 to 3 tenths of a foot in height difference. The variations are caused by the upwelling of water being released from the turbine draft tube and the number of and/or sequence of turbine units operating.

Table 4. LGS average tailrace water elevations, 2012-2017.[1]

Location	Average Tailrace Water Elevations						
	2012	2013	2014	2015	2016	2017	2012 – 2016 Average
SSE	538.67	538.27	538.46	538.34	538.43	538.83	538.43
NPE	538.52	538.22	538.42	538.26	538.34	538.65	538.35
NSE	538.38	538.05	538.48	538.36	538.44	538.76	538.34

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2012-2017.

Overall, average channel to tailwater head differentials in 2017 were slightly higher than average at SSE and NSE and near average at NPE, but values averaged near the middle of the 1.0-2.0 foot differential criteria (Table 5). NPE3 and NSE3 were permanently sealed with concrete in February 2011.

Average entrance weir depths were in or near criteria for 2017 (Table 5). In 2016, NSE weir depths were lower than average due to electrical limits within the FSC software. Project staff were only able to lower weirs to approximately 532.7 feet for the majority of the passage season. Both NSE 1 and 2 were not operational during 2011, 2012 and placed at fixed positions at 531.5 feet in elevation. In 2013, NSE1 and 2 were placed at fixed position of 532.0 feet to compensate for two pump operation. New NSE weir gate hoists were installed and commissioned on February 27, 2014, which allowed the weirs to be adjusted. New FSC software was placed into operation in 2016, but failed to maintain fishway criteria while operating in automatic mode and the system was returned to manual operation.

Table 5. LGS adult fishway average differentials and weir depths 2012-2017.[1]

Location	Average Differential or Depth in Feet						
Channel to Tailwater Differential	2012	2013	2014	2015	2016	2017	2012 – 2016 Average
SSE	1.68	1.69	1.54	1.21	1.41	1.40	1.51
NPE	1.66	1.77	1.49	1.61	1.67	1.65	1.64
NSE	1.48	1.67	1.31	1.09	1.32	1.29	1.37
Weir Depth							
SSE-1	8.34	8.31	8.28	8.49	8.44	8.73	8.37
SSE-2	8.31	8.29	8.21	8.45	8.38	8.68	8.33
NPE-1	6.40	6.15	6.32	5.46	6.47	6.99	6.16
NPE-2	6.22	6.83	6.33	5.47	6.45	6.94	6.26
NSE-1	6.87	6.05	6.35	6.48	5.74	6.63	6.30
NSE-2	6.89	6.05	6.35	6.53	5.62	6.60	6.29

[1] Data compiled from Appendix 1 and previous monitoring report appendixes for years 2012-2017.

Fishway Modifications and Improvements

Fishway System Control (FSC) panel and software was installed in 2016. The new software was installed to automatically adjust adult fish entrance weirs and ensure the adult

fishway remained in criteria. Unfortunately, improper data was programmed and the automatic controls did not function as expected. Therefore, the control system was operated in manual for the 2017 season.

Adult Fish Facility Recommendations

1. Repair and/or replace ladder expansion joint seals
2. Repair and/or replace collection channel sluice gates and indicator rods
3. Continue to replace diffuser grating and supporting beams
4. Replace the North Shore Rip Rap dike that protects the NSE entrance from turbulent water forces created by the north shore clockwise eddy.
5. Repair or replace the Fishway Control System
6. Rotate the rebuild of fish pump gear boxes to ensure the ability to run on three fish pumps

Juvenile Fish Facility

Facility Description

The Little Goose Juvenile Fish Facility was designed to bypass juvenile salmon and steelhead to the tailrace, or to collect for transport by truck and barge below Bonneville Dam. The bypass system includes extended length submersible bar screens in the turbine intakes, vertical barrier screens, 12-inch diameter gatewell orifices, a 14-inch diameter gatewell orifice, a collection channel running the length of the powerhouse, a dewatering structure, two emergency bypass routes, and a corrugated metal flume.

The transport system includes a fish separator, fish distribution system, raceways, a sampling and marking building, truck and barge loading areas, and a passive integrated transponder (PIT) tag detection and diversion / bypass system. Untagged fish (without PIT tags) may also be bypassed from the transport system.

Juvenile Fish Collection and Bypass

Migration and Collection

The juvenile fish bypass and collection facility was placed into primary bypass operations on March 20. Every other day collection for sampling began at 0700 on April 01. A total of 3,083,681 smolts were collected during the 2017 season (Table 6). Of those, 1,461,318 were transported, 1,613,681 were bypassed, and 8,682 were facility (separator, raceway, or sample) mortalities.

Table 6. Annual collection, bypass, and transport activity at Little Goose Dam JFF, 2012-2017

	Chinook Yearling		Chinook Sub-yearling		Steelhead		Coho		Sockeye		
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total
					Collection						
2012	1,067,044	431,462	268,235	399,054	658,540	312,732	775	52,541	252	25,583	3,216,218
2013	768,720	257,791	155,896	297,206	864,292	310,421	50	36,839	15,952	6,683	2,713,850
2014	1,487,105	462,499	278,019	463,013	1,013,203	346,944	0	41,542	9,115	51,956	4,153,396
2015	643,606	163,926	169,349	478,654	590,849	158,004	8,276	33,797	11,050	2,818	2,260,329

2016	1,873,536	564,588	203,981	414,605	1,261,259	339,520	29,781	74,575	18,868	4,032	4,784,745
2017	957,932	380,014	236,813	386,867	812,224	252,851	17,941	25,257	7,164	6,618	3,083,681
					Bypass						
2012	242,353	145,896	1	125	227,179	60,328	0	1,601	0	691	678,174
2013	24,036	22,662	5	343	56,575	9,627	0	200	0	2	113,450
2014	78,418	102,125	0	294	178,448	32,046	0	600	0	5,911	397,842
2015	192,212	69,754	0	140	191,460	21,760	400	1,320	0	40	477,086
2016	1,032,728	382,708	1	2,876	766,337	163,410	3,600	10,000	6	1	2,361,667
2017	554,485	282,676	3,282	15,172	612,738	138,805	1,200	2,001	0	3,322	1,613,681
					Truck						
2012	1	0	133	6,306	17	26	0	7	0	106	6,596
2013	0	0	638	25,106	13	18	0	4	2	16	25,797
2014	0	4	400	7,520	4	6	0	0	0	34	7,968
2015	1	1	44	5,982	35	8	0	9	0	2	6,082
2016	0	0	1,345	10,576	23	3	0	0	0	0	11,947
2017	0	0	435	6,156	5	3	0	0	5	41	6,645
					Barge						
2012	824,116	285,393	267,834	391,916	431,232	252,302	775	50,931	252	24,775	2,529,526
2013	744,193	235,046	155,117	271,046	807,600	300,745	50	36,635	15,950	6,657	2,573,039
2014	1,408,338	360,039	277,207	453,966	834,621	314,847	0	40,932	9,107	45,757	3,744,814
2015	451,267	94,129	168,929	470,315	399,120	136,176	7,868	32,447	11,046	2,772	1,774,069
2016	840,410	181,791	202,183	400,476	494,818	176,078	26,140	64,542	18,645	4,024	2,409,107
2017	399,531	96,175	232,159	363,553	199,312	113,958	16,726	23,230	7,099	2,930	1,454,673
					Total Transport						
2012	824,117	285,393	267,967	398,222	431,249	252,328	775	50,938	252	24,881	2,536,122
2013	744,193	235,046	155,755	296,152	807,613	300,763	50	36,639	15,952	6,673	2,598,836
2014	1,408,338	360,043	277,607	461,486	834,625	314,853	0	40,932	9,107	45,791	3,752,782
2015	451,268	94,130	168,973	476,297	399,155	136,184	7,868	32,456	11,046	2,774	1,780,151
2016	840,410	181,791	203,528	411,052	494,841	176,081	26,140	64,542	18,645	4,024	2,421,054
2017	399,531	96,175	232,594	369,709	199,317	113,961	16726	23,230	7,104	2,971	1,461,318

Transportation

Collection for transport in 2017 began at 0700 on May 1 and ended at 0700 on November 1. An estimated total of 1,486,759 salmonid smolts were collected for transport during this period. Of this total, 1,454,673 smolts were barged, 6,645 were trucked, 17,998 were bypassed, and 7,443 were facility mortalities.

Juvenile salmonids collected for transport by barge or truck were held in raceways, wet-lab holding tanks, or directly loaded into barges or trucks. Maximum fish holding time prior to transport varied from 24 to 48 hours, depending on the transportation schedule. Transport time from LGS to the approved release point was approximately 2 days by barge or 6 hours by truck. Fish transported by truck were transported in a mild saline solution of 1 to 2 grams per liter to treat presumed Columnaris disease. All fish transport operations were performed without incident in 2017. Daily barging and direct loading operations occurred from May 2 to 25, every-other-day barging occurred from May 27 to August 15, excluding July 20 through 25, and every-other-day trucking occurred from August 17 through the end of the transport season on November 2, excluding September 6 to 20. The facility was placed into secondary bypass from July 20 to 25 due to a drawbridge on the Columbia River being stuck in the down position,

blocking all barge transport. The facility was placed into secondary bypass again from September 6 to 20 when the Eagle Creek Wildfire caused traffic closures to Interstate 84 and Washington State Route 14 preventing access of fish transport trucks to their regular release site near Bonneville Dam.

A total of 1,461,318 juvenile salmonids were transported from LGS in 2017; 1,454,673 of them, or 99.5%, were transported by barge (Table 6). The estimated species composition and clip type of the fish transported by barge was: clipped yearling Chinook salmon 27.5%; unclipped yearling Chinook salmon 6.6%; clipped subyearling Chinook salmon 16.0%; unclipped subyearling Chinook salmon 25.0%; clipped steelhead 13.7%; unclipped steelhead 7.8%; clipped sockeye salmon 0.5%; unclipped sockeye salmon 0.2%; clipped coho salmon 1.1%; and unclipped coho salmon 1.6%.

Of the 1,461,318 juvenile salmonids transported from LGS, 6,645, or 0.5% of the total, were transported by truck. The species composition of salmonids transported by truck was: clipped subyearling Chinook salmon 6.5%; unclipped subyearling Chinook salmon 92.6%; clipped steelhead 0.1%; and unclipped steelhead 0.0%; clipped sockeye salmon 0.1%; and unclipped sockeye salmon 0.6%. No yearling Chinook salmon or coho salmon were transported by truck in 2017.

In previous years, due to high numbers of fish collected, Lower Granite Fish Facility trucked Little Goose Fish using the 3500 gallon tanker. This "piggyback" operation delayed transport time for those fish transported from Lower Granite by approximately one hour. In 2017, Little Goose did not conduct any piggybacking operations with Lower Granite. Fish transported by truck from Little Goose were transported in a mild saline solution of 1 to 2 mg/L to reduce stress and treat Columnaris disease.

The maximum daily estimated collection of 298,107 fish occurred on April 28 and accounted for 9.7% of total collection (Table 7). The composition of the collection for that date was: clipped yearling Chinook salmon (38.8%); unclipped yearling Chinook salmon (11.7%); clipped steelhead (40.0%); unclipped steelhead (9.3%); unclipped sockeye salmon (0.4%); clipped sockeye salmon (0.3%); clipped coho salmon (0.1%); and unclipped coho salmon (0.1%).

Table 7. Peak passage dates and totals by species group at Little Goose Dam JFF, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Season
2012	30-Apr (176,464)	30-Apr (76,835)	16-Jun (25,750)	4-Jun (23,025)	30-Apr (104,051)	30-Apr (29,612)	29-May (150)	23-May (3,000)	19-May (4,200)	30-Apr (389,763)
2013	May 10 (156,233)	May 10 (44,008)	June 10 (15,290)	June 08 (14,452)	May 14 (107,846)	May 14 (46,209)	May 17 (4,600)	May 19 (2,400)	May 14 (5,200)	May 10 (280,443)
2014	May 06 (156,006)	April 22 (53,031)	June 02 (19,016)	June 03 (24,044)	April 22 (89,625)	May 08 (25,215)	May 10 (3,600)	May 20 (4,003)	May 10 (6,813)	May 06 (279,206)
2015	April 28 (53,656)	April 24 (16,602)	May 29 (15,400)	July 13 (18,551)	April 28 (66,016)	May 09 (11,601)	May 19 (3,500)	May 12 (400)	May 17 (4,700)	April 28 (136,712)

2016	April 30 (180,800)	April 18 (62,401)	June 11 (15,750)	June 11 (25,750)	April 24 (183,201)	April 30 (28,400)	May 21 (3,750)	May 11 (400)	May 9 (13,200)	April 24 (432,007)
2017	28-Apr (115,678)	16-Apr (50,001)	6-Jun (16,772)	2-Jun (16,208)	28-Apr (119,203)	28-Apr (27,601)	20-May (803)	26-Apr (1,209)	18-May (3,200)	28-Apr (298,107)

Bypass

The juvenile fish bypass system was operated in primary bypass from March 28, 2017, when the facility was watered up, until 0700 on April 1 when collection for condition sampling began. During primary bypass, there is no estimate of the number of fish passing through the facility. On April 1, the facility was placed in secondary bypass for 24-hour sampling for fish condition monitoring from 0700 to 0700 hours and every other day after that until 0700 on May 1 when collection for every day transport began. The estimated number of salmonids bypassed on the 15 sampling dates in April totaled 1,595,683 fish, for an average of 106,379 fish per day.

Fish bypassed during the transportation season, May 2 through November 2, included 74 Chinook salmon fry, two sockeye salmon fry, and one coho salmon fry which were bypassed for continued growth, five unclipped subyearling Chinook salmon, two clipped steelhead, and one unclipped sockeye which were bypassed due to extensive disease and/or injuries, and two unclipped Chinook salmon which escaped from holding tank one.

In addition, the facility was placed into secondary bypass from July 20 to 25 due to a drawbridge on the Columbia River being stuck in the down position preventing all barge traffic from passing. A total of 16,820 fish were bypassed as a result. The facility was placed into secondary bypass again from September 6 to 20 when the Eagle Creek wildfire caused road closures on Interstate 84 and Washington State Route 14 preventing the fish transport trucks from reaching their regular release site near Bonneville Dam. A total of 1,091 fish were bypassed during this time period. These were the only instances of the facility being placed into primary or secondary bypass during the 2017 transportation season (May 1 through November 2).

Adult Fallbacks

Fallbacks are adult salmonids that have migrated above the dam and have “fallen back” into the downstream juvenile fish collection and bypass system. Fallbacks collected at the separator were usually too large to pass between the separator bars and were released back to the river. Fallbacks were identified by species and fin clip and assessed for condition prior to being released.

A total of 2,962 adult salmon and steelhead fallbacks occurred in 2017 (Table 8). Of these, 2,954 were bypassed from the separator. The remaining 8 were small Chinook salmon and 4 small adult steelhead that passed through the separator bars and were collected in the sample and released back to the river.

There were 930 steelhead fallbacks in April, May and June (Table 9). Of these there were 452 clipped and 431 unclipped which were classified as out-migrating kelts. Due to their post spawned condition, kelts collected during this period accounted for the majority of fish in fair, poor, and dead condition. Table 10 lists the numbers of fish by species and condition.

Other fish of particular interest that were bypassed back to the river from the separator and/or raceways included 232 adult Pacific lamprey and 3 white sturgeon. The 232 adult pacific lamprey were transported to one mile above the dam and released.

Table 8. Total annual adult salmonid fallbacks at Little Goose Dam JFF, 2012-2017.

Year	Adult Chinook	Jack/mini Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
2012	1,064	1,077	1,215	1,399	9	21	4,785
2013	1,341	1,050	1,469	1,061	15	2	4,938
2014	991	558	1,518	1,425	46	186	4,724
2015	515	240	659	903	15	10	2,342
2016	643	452	1049	1272	17	9	3,442
2017	1,345	455	583	528	4	47	2,962

Table 9. Monthly totals of fallbacks bypassed from separator at Little Goose Dam, 2017.

Month	Adult Chinook	Jack Chinook	Clip Steelhead	Unclip Steelhead	Sockeye	Coho	Total
April	0	0	311	237	0	0	548
May	42	9	100	135	0	0	286
June	214	48	61	86	0	0	409
July	85	31	0	3	3	0	122
August	26	5	1	6	0	0	38
September	157	67	34	8	0	12	278
October	821	295	76	53	1	35	1,281
Total	1,345	455	583	528	4	47	2,962

Table 10. Condition of adult salmonids released at Little Goose Dam, 2017.

Fish	Chinook		Chinook Jack		Steelhead		Sockeye		Coho	
Condition[1]	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
Good	645	601	246	190	343	371	3	1	41	2,441
Fair	57	26	11	3	136	83	0	0	6	322
Poor	13	2	3	2	89	60	0	0	0	169
Dead	1	0	0	0	15	14	0	0	0	30
Total	716	629	260	195	583	528	3	1	47	2,962

[1] Condition ratings for live fish were determined subjectively based on the presence/absence and severity of fungus, headburn, fin wear, and other injuries.
Note: Table 10 does not separate post spawned "kelt" steelhead from pre-spawned healthier steelhead.

Separator Efficiency

Separator efficiency is a measure of how efficiently fish entering the facility are separated by size. Smaller fish, primarily salmon smolts, are expected to enter through the narrowly spaced A-side sorter bars on the upstream end of the separator, and the larger fish, primarily steelhead, should enter through the more widely spaced B-side sorter bars on the downstream end. Table 11 gives efficiency expressed as the percentage of each group, passing through the desired side of the separator, for 2012 to 2017. Efficiency rates are based on expanded sample counts.

Separator efficiency was highest for clipped and unclipped steelhead, with 85.8% of clipped steelhead and 69.6% of unclipped steelhead entering on B-side. Separator efficiency was lowest for clipped sockeye salmon and unclipped coho salmon with 11.2% of clipped sockeye salmon and 22.0% of unclipped coho salmon entering on A-side (Table 11).

Table 11. Annual juvenile salmonid separator efficiency (%) at Little Goose Dam JFF, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye	
Year	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side	Clip B-side	Unclip B-side	Clip A-side	Unclip A-side	Clip A-side	Unclip A-side
2012	75.1	72.3	59.1	59.9	83.7	64.8	45.2	42.1	0.0	37.7
2013	71.5	71.2	53.8	48.8	82.1	62.1	100.0	23.7	64.5	52.4
2014	81.8	78.6	58.5	56.5	75.9	54.7	—	41.3	49.5	37.6
2015	72.9	69.3	65.8	62.8	72.7	57.0	39.0	35.9	45.2	38.2
2016	65.4	64.0	57.3	56.1	88.6	68.7	36.0	32.2	23.9	27.3
2017	62.0	56.5	45.6	46.9	85.8	69.6	24.9	22.0	11.2	34.8

Note: Counts do not include sample mortalities. There were no clipped coho sampled in 2014.

Sampling

The fish sampling system was operated without incident throughout the 2017 season. Sampling procedures followed the smolt monitoring guidelines developed by the Fish Passage Center and USACE. The resulting data were used for management of facility and fish transport operations. Collection and fish condition data were also transmitted daily by ODFW personnel to the Fish Passage Center electronic database in support of the Smolt Monitoring Program (SMP).

Sample rates were set by USACE project biologists. To obtain the target sample of 300 to 500 smolts, sample rates were varied between 0.25 and 100.0% as fish migration numbers fluctuated. The percentage of each species sampled was dependent on their migration timing and the overall sample rate in effect at that time (Table 12).

Table 12. Annual percentages of juvenile salmonids collected per species and clip type that were sampled at Little Goose Dam JFF, 2012-2017[1].

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2012	0.6	0.8	5.1	15.4	0.8	1.0	0.7	1.5	0.8	2.6
2013	0.4	0.7	3.0	6.1	0.6	0.6	0.6	0.9	0.6	1.4
2014	0.8	1.0	2.8	4.7	1.0	1.1	0.9	0.9	1.0	1.8
2015	0.3	0.5	4.7	7.8	0.5	0.6	2.9	1.0	0.7	1.3
2016	0.5	0.5	3.1	5.0	0.5	0.7	1.3	1.1	1.3	1.6
2017	0.5	0.5	3.3	6.4	0.5	0.7	1.3	1.9	1.2	1.5

[1]All research fish and sample mortality are included in percentages.

All fish in the sample were examined to determine species, clip type, and prevalence of descaling. In addition, Chinook salmon age class was determined as subyearling or yearling. All yearling Chinook salmon in the sample were examined for characteristics typical of holdover or

Lyons Ferry Hatchery fall Chinook salmon. All unclipped salmon were scanned for coded wire tags. Chinook, sockeye and coho fry were defined by length, under 60 mm, and were bypassed for continued growth. None of the 2017 hatchery releases above LGS were marked with elastomer eye tags.

Fish condition data were collected from a random subsample of 100 fish from the dominant species in the daily sample. Data collected included weight, length, descaling, injury, disease, predation, and "other" monitored conditions including pink fin, fin hemorrhage, fin discoloration, popeyes (exophthalmos), and eye hemorrhage. Injury and descaling data were used by managers to assess passage conditions at the dam.

Pound counts (number of fish per pound) were taken daily during condition sampling and provided to USACE from April 2 through October 31, 2017. During transport, when the sample rate was set below 100.0%, weights were also recorded on all non-salmonid species in the sample to determine their contribution to barge loading densities.

A total of 45,545 fish were sampled during the 2017 season. Of these, 43,270 were examined for descaling, 77 were salmonid fry, 247 were sample mortalities, and 1,951 smolts were removed from the separator during GBT monitoring (Table 13).

Table 13. Weekly sample as percent of collection total and sample totals at LGS JFF, 2017.

Week Ending	Weekly % Sampled (%)	Yearling Chinook Clip	Yearling Chinook Unclip	Subyearling Chinook Clip	Subyearling Chinook Unclip	Steelhead Clip	Steelhead Unclip	Sockeye Clip	Sockeye Unclip	Coho	Totals[1]
6-Apr	0.8	59	24	0	1	103	43	0	3	1	234
13-Apr	1.0	284	165	0	0	462	97	0	4	3	1,015
20-Apr	0.3	342	328	0	0	473	108	0	0	2	1,253
27-Apr	0.3	503	241	0	1	588	104	0	5	3	1,445
4-May	0.3	919	199	0	0	560	148	0	1	3	1,830
11-May	0.4	425	70	0	0	279	93	0	2	15	884
18-May	1.4	1,317	297	0	3	557	468	23	3	162	2,830
25-May	1.1	478	147	0	10	397	320	41	8	138	1,539
1-Jun	2.1	174	214	879	1,404	343	288	21	22	140	3,485
8-Jun	1.4	15	22	1,289	1,561	127	100	2	6	34	3,156
15-Jun	2.4	5	11	943	1,086	64	47	2	2	11	2,171
22-Jun	4.0	3	17	801	1,085	83	40	1	1	14	2,045
29-Jun	6.4	4	10	940	1,486	50	13	0	2	10	2,515
6-Jul	7.4	2	3	887	2,212	17	2	0	2	3	3,128
13-Jul	5.3	0	4	396	1,374	6	1	0	3	0	1,784
20-Jul	13.3	0	0	350	1,741	3	1	0	3	0	2,098
27-Jul	10.8	0	0	531	2,549	2	0	0	3	0	3,085
3-Aug	14.5	0	0	103	1,067	4	0	0	0	0	1,174
10-Aug	48.9	0	0	106	1,068	6	1	0	2	0	1,183
17-Aug	67.6	0	0	140	1,654	3	1	1	0	0	1,799
24-Aug	100.0	0	0	24	393	1	1	0	0	0	419
31-Aug	100.0	0	0	22	248	1	0	0	2	0	273
7-Sep	99.7	0	0	24	306	2	0	0	2	0	334
14-Sep	100.0	0	0	30	393	2	0	0	0	0	425
21-Sep	100.0	0	0	57	514	0	0	1	1	0	573
28-Sep	100.0	0	0	46	576	0	0	1	7	0	630
5-Oct	100.0	0	0	52	477	1	0	0	6	0	536
12-Oct	100.0	0	0	63	1,006	0	1	0	16	0	1,086

19-Oct	100.0	0	0	74	1,305	1	0	3	12	0	1,395
26-Oct	100.0	0	0	53	810	0	0	0	3	0	866
2-Nov	100.0	0	0	19	332	1	0	0	3	0	355
Total Sampled		4,530	1,752	7,829	24,662	4,136	1,877	96	124	539	45,545
Total Collection		957,932	380,014	236,813	386,867	812,224	252,851	7,164	6,618	43,198	3,008,611
Percent of Sample		9.9	3.8	17.2	54.1	9.1	4.1	0.2	0.3	1.2	100.0
Percent of Collection		31.1	12.3	7.7	12.5	26.3	8.2	0.2	0.2	1.4	100.0

[1]All research fish, GBT fish and sample mortality included in species group and clip type numbers.
[2]Separator mortalities are included in collection totals but are not sampled.
[3]Note: Little Goose JFF was in secondary bypass mode at 0700, switching to 24-hour condition sampling on April 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, and 30. Collection for transport with daily 24-hour sampling began at 0700 on May 1 and ended at 0700 on October 31.

Fish Condition

Fish condition was monitored daily by Anchor QEA and ODFW biologists. "The primary role of the condition monitoring is to identify the proportion of each species of migrant juvenile salmonid and larval and juvenile lamprey (where applicable) that are descaled (salmonids only) or have significant injuries indicative of problems in fish passage at dams such as debris in fish bypass apparatus. Secondarily, the data collected on disease, predation, and other injuries will provide a relative indication of the health of fish passing at the dams." (Condition Sampling Protocol, 2017 Smolt Monitoring Season).

Injuries

Prior to 2009, recorded injuries were based solely on the presence of an injury, with no attempt made to determine the age or origin of the injury. From 2009 to date, only fresh injuries presumed to have occurred during passage through Little Goose Dam have been recorded (Table 14).

Table 14. Annual injury rates (%) for salmonids examined at Little Goose Dam, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total
2012	2.5	2.7	4.9	6.0	2.0	3.3	0.0	1.8	2.7	4.6
2013	3.4	4.3	8.9	17.0	1.8	1.6	0.0	3.2	2.9	12.1
2014	8.4	8.4	9.0	12.3	4.3	3.4	13.3	12.9	8.6	9.8
2015	12.5	14.1	12.9	16.6	6.2	5.5	7.0	11.5	11.1	13.4
2016	10.2	12.2	19.5	23.5	0.1	6.4	5.6	13.5	14.8	17.9
2017	9.9	10.6	12.3	16.6	5.4	4.9	11.8	7.8	7.1	13.0

A total of 21,764 smolts from the condition subsample were examined for injuries. Of the fish examined, 13.0% or 2,836 individual smolts were observed with one, or more than one, injury. A total of 2,892 individual injuries were observed this year. The majority of injuries involved damage to fins (87.8%) followed by operculum injury (6.8%), body injury (3.1%), head injury (1.4%), and eye injury (1.0%; Table 15). The highest rates of injury this year were observed in subyearling fall Chinook salmon at 16.6% for unclipped and 12.3% for clipped.

Table 15. Percent of fish examined that were injured, had predation marks, or had signs of disease by species and clip type at Little Goose Dam, 2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Coho		Sockeye		
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip	Total[1]
Injuries											
Eye	0.5	0.3	<0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.1
Operculum	0.5	1.0	0.7	0.7	2.5	1.9	0.5	0.3	2.2	0.0	0.9
Head	<0.1	0.2	0.2	0.2	0.4	0.1	1.1	0.0	1.1	0.0	0.2
Body	0.3	0.3	0.3	0.4	0.7	0.6	0.5	0.0	0.0	0.0	0.4
Fin	8.8	9.1	11.3	15.7	1.9	2.2	6.9	5.7	8.6	7.8	11.7
Total Injury	**9.9**	**10.6**	**12.3**	**16.6**	**5.4**	**4.9**	**9.0**	**6.0**	**11.8**	**7.8**	**13.0**

Disease											
Fungus	0.5	0.2	0.2	0.1	0.5	0.6	0.0	0.3	2.2	3.9	0.3
Columnaris	0.0	0.0	1.1	2.5	0.1	0.1	0.0	0.0	4.3	15.5	1.6
BKD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Parasites	0.4	1.3	0.2	0.2	1.4	7.7	0.5	0.3	0.0	0.0	0.8
Deformity	0.2	0.2	0.6	0.5	0.1	0.0	0.0	0.3	0.0	1.0	0.4
Disease Other	0.2	0.2	0.8	1.2	0.4	0.3	0.0	0.3	3.2	1.0	0.8
Total Disease	**1.2**	**1.9**	**3.1**	**4.5**	**2.5**	**8.6**	**0.5**	**1.3**	**8.6**	**21.4**	**3.8**
Predation											
Bird	1.0	0.3	0.3	0.5	2.7	2.2	0.5	0.0	2.2	1.9	0.9
Fish	1.4	1.1	1.7	1.9	0.6	0.4	1.1	0.9	2.2	1.9	1.5
Lamprey	0.0	0.0	<0.1	<0.1	0.1	0.0	0.0	0.0	0.0	0.0	<0.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Predation	**2.4**	**1.4**	**2.0**	**2.5**	**3.4**	**2.6**	**1.6**	**1.0**	**4.3**	**3.9**	**2.4**
Misc. Conditions											
Pop Eye	0.2	0.1	0.1	0.1	0.2	0.0	0.0	0.3	1.1	0.0	0.1
Fin Hemorrhage	3.6	6.5	15.2	16.6	1.2	2.9	3.2	3.2	22.6	3.9	11.9
Pink Fin	6.0	5.9	26.8	37.1	5.5	7.7	2.1	0.6	2.2	8.7	25.0
Fin Discoloration	0.5	0.4	4.3	7.1	0.4	0.2	0.0	0.0	0.0	7.8	4.4
Eye Hemorrhage	0.5	0.5	0.2	0.1	0.3	0.4	0.5	0.3	1.1	1.0	0.2
Total Misc. Conditions	**9.9**	**12.3**	**38.5**	**48.4**	**7.3**	**10.3**	**5.9**	**4.4**	**24.7**	**16.5**	**33.8**
Total sample size	**2,419**	**982**	**2,791**	**11,525**	**2,258**	**1,088**	**188**	**317**	**93**	**103**	**21,764**

[1] Overall disease and injury rates are less than the sum of the individual categories because some individual fish had more than one injury or disease.
BKD = bacterial kidney disease

Descaling

All live smolts in the sample were examined for descaling. A smolt was considered descaled if more than 20% of the scales were missing from either side of the fish. Only descaling that appeared fresh enough to have occurred at LGS was recorded. Prior to 2009, all descaling, old or new, was recorded.

A total of 43,270 smolts were examined for descaling in 2017. Smolts examined for descaling include live smolts in the sample and do not include smolts examined for GBT, sample mortalities, or fry. The overall rate of descaling was 1.5% (639 descaled), which is slightly higher than rates observed in previous years (Table 16). Of the 43,270 smolts examined for descaling, 50.3% (21,764) were examined as part of condition subsampling. During condition subsampling, fish with descaling greater than or equal to 20.0% were differentiated into two categories: 1) descaling associated with dam passage, and 2) descaling on fish with bite marks indicative of predation attempts by birds, fish, or lamprey. The rate of descaling observed in the condition subsample was 1.8% (390 descaled smolts). Of the 390 descaled smolts observed in the condition subsample, descaling associated with dam passage was 66.9% of the condition descale total, and the rate of descaling on fish with predation marks present was 33.1% of the condition descale total. The rate of descaling observed in the non-condition sample was 1.2% (249 descaled smolts) from a sample size of 21,506 salmon. Note that all descaling recorded from the non-condition sample does not differentiate between descaling as a result of passage and descaling as a result of predators.

Table 16. Annual descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Totals
2012	1.0	0.6	0.5	0.9	0.8	1.4	0.0	1.9	0.6	0.9
2013	0.7	1.0	0.8	1.0	0.6	0.8	0.9	1.1	0.7	0.9
2014	1.2	0.5	1.0	0.9	1.0	1.2	0.0	3.4	1.9	1.0
2015	1.3	1.1	0.7	0.7	1.9	1.9	0.0	3.8	1.4	1.0
2016	1.1	0.7	1.0	1.5	1.2	1.2	1.3	2.4	1.8	1.3
2017	2.2	1.5	1.2	1.4	1.5	0.8	3.1	6.5	1.7	1.5

Note: GBT sample numbers not included in descaling rate calculations.

For fish in the condition subsample, in addition to descaling of 20% or greater, partial descaling was also recorded. Partial descaling was considered scale loss above background levels of approximately 5% scale loss but below the 20% threshold for descaling. The rate of partial descaling was 4.5% of the 21,764 smolts examined for condition in 2017.

Overall weekly descaling rates per species and clip types are listed in Table 17. The average weekly descaling rate ranged from 0.1% to 6.5%.

Table 17. Weekly descaling rates (%) for salmonids examined at Little Goose Dam JFF, 2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total[1]
6-Apr	0.00	0.00	—	—	2.91	0.00	—	0.00	0.00	1.30
13-Apr	1.90	1.46	—	—	0.52	2.67	—	0.00	0.00	1.23
20-Apr	2.60	1.95	—	—	2.11	0.00	—	—	0.00	2.00
27-Apr	1.50	0.88	—	—	1.85	0.99	—	25.00	33.33	1.64
4-May	3.25	2.66	—	—	1.52	1.43	—	0.00	0.00	2.50
11-May	2.51	4.48	—	—	3.13	0.00	—	0.00	0.00	2.57
18-May	2.20	1.39	—	0	1.53	0.45	4.35	—	0.62	1.62
25-May	1.53	1.39	—	0	0.86	1.37	2.44	25.00	1.50	1.46
1-Jun	1.19	0.47	0.59	0.59	0.62	0.71	0.00	0.00	2.86	0.71
8-Jun	0.00	0.00	0.41	0.33	1.69	0.00	0.00	0.00	0.00	0.40
15-Jun	0.00	0.00	0.67	0.58	0.00	0.00	0.00	0.00	0.00	0.58
22-Jun	0.00	0.00	1.32	1.48	3.95	2.56	0.00	0.00	0.00	1.51
29-Jun	0.00	0.00	0.67	0.43	0.00	0.00	—	0.00	0.00	0.50
6-Jul	0.00	0.00	1.63	0.98	0.00	0.00	—	0.00	33.33	1.19
13-Jul	—	—	1.61	1.09	0.00	0.00	—	0.00	—	1.20
20-Jul	—	—	1.78	1.43	0.00	0.00	—	0.00	—	1.48
27-Jul	—	—	2.14	2.29	0.00	—	—	0.00	—	2.26
3-Aug	—	—	2.15	2.29	0.00	—	—	—	—	2.27
10-Aug	—	—	4.35	1.13	0.00	0.00	—	0.00	—	1.40
17-Aug	—	—	0.75	0.97	0.00	—	100.00	—	—	1.01
24-Aug	—	—	0.00	1.08	0.00	0.00	—	—	—	1.02
31-Aug	—	—	0.00	2.03	0.00	—	—	—	—	1.86
7-Sep	—	—	0.08	0.01	0.00	—	—	0.00	—	0.02
14-Sep	—	—	0.03	0.01	0.00	—	—	—	—	0.01

21-Sep	—	—	0.04	0.02	—	—	0.00	0.00	—	0.02
28-Sep	—	—	0.02	0.03	—	—	0.00	0.14	—	0.03
5-Oct	—	—	0.02	0.02	0.00	—	—	0.00	—	0.02
12-Oct	—	—	3.17	1.99	—	0.00	—	6.67	—	2.13
19-Oct	—	—	1.35	2.16	0.00	—	0.00	0.00	—	2.09
26-Oct	—	—	1.89	2.73	—	—	—	0.00	—	2.67
2-Nov	—	—	5.26	6.04	0.00	—	—	66.67	—	6.50
Total Exam.	**4,228**	**1,650**	**7,493**	**23,662**	**3,745**	**1,752**	**96**	**107**	**537**	**43,270**
Percent Desc.	**2.22**	**1.52**	**1.17**	**1.45**	**1.52**	**0.80**	**3.13**	**6.54**	**1.68**	**1.48**
Median	**1.35**	**0.68**	**0.75**	**0.98**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.40**

[1] Descaling figures do not include sample mortalities or fish examined for GBT.
[2] "-----" means species group not present in sample during this week.

Disease

Data on the presence of disease symptoms were collected from fish in the condition subsample to provide relative information about fish health. Disease classifications included fungus, Columnaris, BKD, body parasites, deformity, and other disease such as cysts or tumors. 2014 was the first season parasites were identified and documented to genus which included fish louse (*Argulus*), gill lice (*Salmincola*), and leech (*Piscicola*). Types of deformity including spinal curvatures such as scoliosis and lordosis, and also dwarfism or truncated body were also documented.

A total number of 835 smolts (3.8%) of the total condition subsample were observed with one or more symptoms of disease (See Table 15 above). Of the 843 individual signs of disease observed this year, Columnaris was the most prevalent at 40.5% of the total, followed by other disease (21.7%), parasite (20.6%), deformity (10.3%), fungus (6.9%), and presumed bacterial kidney disease (0.0%). Almost all the other diseases this season consisted of observations of sick subyearling fall Chinook salmon smolts with symptoms of abdominal distention similar to BKD. In 2015, several subyearling fall Chinook salmon smolt mortalities were observed with these symptoms which prompted ODFW to collect a specimen for the ODFW Fish Health Laboratory in La Grande, Oregon. Preliminary results were positive for the intestinal protozoan parasite (*Ceratomyxa shasta*). As a result, nearly all fish exhibiting symptoms of abdominal distention have been reported as "disease other" rather than BKD since 2015.

Predation Marks

Bite marks were recorded on fish from the condition subsample, which were indicative of predation attempts by bird, fish, lamprey, and mammalian predators such as mink and otter. A total of 529 smolts were observed with one or more predatory wounds, for an overall rate of 2.4% of the total condition subsample. The majority of marks observed in the subsample were indicative of attempted predation by fish at 63.7 of the 529 total individual bite marks recorded, followed by bird bites (35.3%), and lamprey bites (0.9%). No mammalian bite marks were observed this year. Steelhead and sockeye sustained the highest rate of predatory attempts, which were predominately a result of predation attempts by birds (See Table 15 above).

The overall rate of bird bite marks decreased from last year and was slightly lower than the 5-year average of 1.0 (Table 18). The highest prevalence of bird bite marks was observed on clipped steelhead.

Table 18. Annual bird bite rates (%) for salmonids examined at Little Goose Dam, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Year	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip	Clipped	Unclip		Total
2012	0.7	0.5	0.1	0.5	3.9	3.8	0.0	0.0	0.0	1.0
2013	1.0	1.0	0.1	0.5	1.8	2.6	2.2	1.6	1.4	0.8
2014	0.5	0.5	0.3	0.3	2.7	2.5	0.0	0.7	0.9	0.7
2015	0.8	0.9	0.2	0.3	4.4	3.3	0.0	3.9	<0.1	1.1
2016	0.8	0.2	0.5	1.6	2.3	2.7	1.7	0.0	1.0	1.4
2017	1.0	0.3	0.3	0.5	2.7	2.2	2.2	1.9	0.2	0.9

Other Miscellaneous Conditions

The other miscellaneous conditions category included popeye (exopthalmos), hemorrhaged fin, pink fin, discolored fin, and hemorrhaged eye. There were 7,359 smolts with one or more miscellaneous conditions, for an overall miscellaneous condition rate of 33.8% of the total condition subsample (See Table 15 above). A total of 9,064 individual observations of miscellaneous conditions were found. Many smolts that were examined had multiple conditions. For example, pink fin and hemorrhaged fins often occurred on the same individual fish, though in different fins. Pink fins constituted most of the observations in this category at 60.1% of the individual miscellaneous conditions total followed by hemorrhaged fin(s) (28.5%), fin discoloration (10.7%), eye hemorrhage (0.5%), and popeye (exopthalmos) (0.3%). Subyearling fall Chinook salmon had the highest rates in this condition category at 48.4% for unclipped and 38.5 for clipped due to the high incidence of pink and hemorrhaged fin(s).

Mortality

Mortality at the JFF included fish that entered the JFF system dead as well as those that died at the facility. Mortality was recorded by location within the facility and was divided into facility mortality (raceways and separator) and sample mortality. Total facility mortality is the sum of facility mortality (raceway and separator) and sample mortality.

Total facility mortality rate this year was roughly three times that of the 5-year average at 0.3% from a total collection of 3,083,681 smolts (Table 19), likely as a result of high flows and subsequent high debris. The average weekly total facility mortality rate ranged from less than 0.1 to 2.4% (Table 20). The minimum weekly rates of less than 0.1% occurred frequently during the months of April and May, when mortalities that occurred represented a small proportion of the total collection. Increased mortality rates later in the collection season occurred when total collection numbers decreased and descaling, disease, predation, and injury rates increased. The average monthly total facility mortality rate was highest in August at a rate of 1.4% from a collection total of 7,470 smolts.

The maximum weekly total facility mortality rate of 2.4% occurred during the week ending August 24, 2017, with a total weekly collection of 419 fish and 10 mortalities. The median season total facility mortality rate for all smolts was 0.5%. The highest number of facility mortalities occurred during the week ending May 4 when a total of 3,171 mortalities were recorded. The high number was the result of two debris-related incidents. On April 28, debris caused a junction box to clog and overflow. A total of 395 smolt mortalities occurred due to the overflow and fish falling to the ground (see memorandum for the record [MFR] 17 LGS 06). On May 3, orifices 3B1 and 3B2 were discovered to be plugged with debris at approximately 0700.

A total of 2,240 mortalities were attributed to this incident (see MFR 17 LGS 07). An additional 536 facility mortalities occurred during the week, presumably from normal operations and the relatively high debris at that time. A third debris-related event outside of this week occurred April 12 when debris plugged the separator and caused water to overflow out of the adult release pipe. A total of 94 smolts overflowed onto the ground as a result (see MFR 17 LGS 05).

In addition to the incidents described above, a fourth debris-related event was discovered on May 1 when tears were found in vertical bar screens during routine vertical bar screen video inspections. The tears were likely caused by forebay debris entering the juvenile fish collection system. Fish entering the system became stuck in the screens and died. A total of 1,800 smolt mortalities were attributed to this incident (see MFR 17 LGS 08). This number is not included in totals in Table 19 or Table 20 because the event occurred outside the juvenile fish facility, and the fish were removed from the collection system prior to reaching the separator.

Sample mortality for smolts was 0.5% of 45,545 smolts sampled (Table 21). As in 2016, increased sample mortality in late summer was observed when river temperatures and outbreaks of disease, such as Columnaris, were higher than in the spring and fall. On average, monthly sample mortality rates were lowest in April at 0.3% from a sample total number of 5,103 smolts. The highest sample mortality rate was in July and August at 0.8% from a sample total number of 14,199 smolts.

The total sample mortality rate for Pacific lamprey ammocoetes was 4.6%, which was 15 of 323 total ammocoete sampled. The sample mortality rate for Pacific lamprey macropthalmia was 2.3%, which was 7 from a total of 306 sampled (Table 21). No notable peak in sample mortality for either life stage of juvenile Pacific lamprey was observed.

Table 19. Annual total facility mortality as a percentage of total collection at LGS JFF 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific lamprey	
Year	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoete	Macropthalmia
2012	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.0	<0.1	0.0	<0.1	0.5	0.3
2013	<0.1	<0.1	0.1	0.2	<0.1	<0.1	0.0	0.1	0.0	0.1	0.2	<0.1
2014	<0.1	0.1	0.2	0.3	<0.1	<0.1	0.1	0.5	<0.1	0.1	0.4	0.2
2015	<0.1	0.1	0.2	0.5	<0.1	<0.1	<0.1	0.1	0.1	0.1	<0.1	<0.1
2016	<0.1	<0.1	0.2	0.2	<0.1	<0.1	1.2	0.2	<0.01	<0.1	0.2	<0.1
2017	0.4	0.3	0.4	0.5	<0.1	<0.1	0.8	4.9	0.1	0.3	0.3	0.3

Note: Mortality rate for collected fish includes sample, raceway, and separator mortalities. Lamprey numbers are not included in "Totals" column.

Table 20. Weekly total facility mortality in percent at Little Goose Dam JFF, 2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho	
Week Ending	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total[1]
6-Apr	0.2	0.1	—	0.0	0.0	<0.1	—	0.7	0.0	<0.1
13-Apr	0.1	0.4	—	—	<0.1	<0.1	—	1.0	0.0	0.1
20-Apr	0.1	0.1	—	100.0	<0.1	<0.1	100.0	100.0	0.0	<0.1
27-Apr	0.1	0.1	—	0.0	<0.1	<0.1	—	1.1	0.1	0.1
4-May	0.7	0.9	—	100.0	<0.1	0.1	—	7.0	0.2	0.5

11-May	0.6	0.7	—	100.0	<0.1	0.1	—	27.6	0.4	0.5
18-May	0.5	0.3	—	0.4	<0.1	<0.1	1.4	22.1	<0.1	0.3
25-May	0.1	0.1	—	0.1	<0.1	<0.1	0.4	1.7	0.1	0.1
1-Jun	0.3	0.2	0.5	0.7	0.1	0.1	0.3	2.0	0.2	0.5
8-Jun	0.1	0.3	0.4	0.5	<0.1	0.1	7.8	6.6	0.0	0.4
15-Jun	0.4	0.0	0.3	0.4	0.0	0.1	2.0	7.0	0.2	0.3
22-Jun	0.0	0.0	0.3	0.2	0.0	0.0	10.0	12.0	0.0	0.3
29-Jun	0.0	—	0.1	0.1	0.1	0.9	—	3.2	0.0	0.1
6-Jul	0.0	—	0.2	0.3	0.0	3.3	—	6.7	0.0	0.3
13-Jul	—	—	0.7	0.6	2.0	0.0	—	6.6	—	0.6
20-Jul	—	—	0.9	0.7	0.0	10.0	—	13.0	—	0.8
27-Jul	—	—	0.6	0.4	0.0	—	—	15.4	—	0.4
3-Aug	—	—	4.0	1.9	3.8	—	—	—	—	2.1
10-Aug	—	—	0.9	1.1	0.0	0.0	—	50.0	—	1.2
17-Aug	—	—	0.5	0.8	0.0	0.0	—	—	—	0.8
24-Aug	—	—	4.2	2.3	0.0	0.0	—	—	—	2.4
31-Aug	—	—	0.0	1.2	0.0	—	—	0.0	—	1.1
7-Sep	—	—	0.0	1.6	0.0	—	—	50.0	—	1.8
14-Sep	—	—	0.0	1.0	0.0	—	—	—	—	0.9
21-Sep	—	—	0.0	2.3	—	—	0.0	0.0	—	2.1
28-Sep	—	—	2.2	1.0	—	—	0.0	28.6	—	1.4
5-Oct	—	—	1.9	0.8	0.0	—	—	16.7	—	1.1
12-Oct	—	—	0.0	0.5	—	0.0	—	12.5	—	0.6
19-Oct	—	—	0.0	0.7	0.0	0.0	0.0	8.3	—	0.7
26-Oct	—	—	0.0	0.5	—	—	—	0.0	—	0.5
2-Nov	—	—	0.0	0.3	0.0	—	—	0.0	—	0.3
Median Weekly Rate	0.1	0.15	0.3	0.7	0	<0.1	0.9	7	<0.1	0.5

[1]Total facility mortality includes facility, sample and raceway mortality.
Note "-----" indicates that the species group was not present in the sample during the week

Table 21. Annual sample mortality as percent of total sample at Little Goose Dam JFF, 2012-2017.

	Yearling Chinook		Subyearling Chinook		Steelhead		Sockeye		Coho		Pacific Lamprey	
	Clip	Unclip	Clip	Unclip	Clip	Unclip	Clip	Unclip		Total	Ammocoetes	Macropthalmia
2012	0.4	0.3	0.3	0.5	0.2	0.2	0.0	0.8	0.0	0.4	10.8	4.5
2013	0.2	0.1	0.3	0.8	0.1	0.1	0.0	4.1	0.0	0.6	3.8	1.9
2014	0.3	0.3	0.3	0.8	0.2	0.1	1.7	4.7	0.4	0.6	20.4	5.6
2015	0.2	0.5	0.3	0.9	0.2	0.2	2.0	0.0	0.0	0.6	20.0	4.1
2016	0.3	0.2	0.4	0.4	0.2	0.1	4.0	0.0	0.1	0.4	8.6	3.8
2017	0.5	0.4	0.4	0.7	0.2	0.1	0.0	12.1	0.2	0.5	4.6	2.3

Note: Mortality rate in sampled fish excludes research, raceway, and separator mortalities. Includes GBT sample fish. Pacific lamprey mortalities are not included in the total mortalities to facilitate across year comparisons. In 2014, the sample mortality rate for Pacific lamprey ammocoete includes 2 unknown ammocoetes.

Incidental Species

The total incidental fish collection was determined by using the sample rate to expand the number of incidental fish in the sample and adding the number of incidental fish removed from the separator to the expanded sample count. Incidental species were counted individually, except when handling large numbers of Siberian prawn. When the number of Siberian prawn was too

large to practically count each individual, a weekly fish per pound calculation was obtained for these species; the result was then multiplied by the daily weight of the sampled species to obtain an estimated count for the day. All sampled incidental fish were returned to the river except for Siberian prawn. All Siberian prawns that occurred in the sample were euthanized per the directive issued by Washington Department of Fish and Wildlife on July 24, 2007. All Siberian prawns from the sample were frozen and disposed into a landfill.

When the sample rate was less than 100%, incidental species were inadvertently collected and transported along with the smolts. Therefore, when the sample rate was below 100%, incidental fish species were weighed, and the average weight was applied to the expanded sample count to determine their contribution to transport loading densities.

Incidental collections totaled 234,875. This included an expanded sample count of 142,484 fish and 31,668 crustaceans, plus 60,723 fish from the separator (Table 22). Siberian prawn collection numbers were highest during the month of August, totaling 13,007, or 41.1% of all Siberian prawns collected for the season. For the second year in a row, juvenile American shad collection totals were substantially higher than previous years and accounted for the majority of total incidental collection numbers. Of the 136,249 juvenile American shad collected for the season, 90,248 (66.2%) occurred between October 1 and November 2. Numbers of smallmouth bass (*Micropterus dolomieu*), bullhead (*Ameiurus* sp.), common carp (*Cyprinus carpio)*, suckers (*Catostomus* sp.), crappie (*Pomoxis* sp.) peamouth (*Mylocheilus caurinus*), mountain whitefish (*Prosopium williamsoni*), Pacific lamprey ammocoete (*Entosphenus tridentatus*), and sunfish (*Lepomis* sp.) were much higher than in 2016 (Table 23), while sculpin (*Cottus* sp.), Pacific lamprey macropthalmia (*Entosphenus tridentatus*), and white sturgeon (*Acipenser transmontanus)* collection numbers were significantly lower. Collection totals for most other groups that contribute substantial numbers to the incidental collection were similar to those in 2016.

Adult Pacific lamprey (*Entosphenus tridentatus*) collections totaled 232 in 2017, 137 from the separator and raceways and 95 from the sample. The first adult Pacific lamprey of the season was collected May 30 and the last on November 1. Upriver adult migrants were most frequently observed falling back into the collection system from July through August. USACE transported all adult Pacific lamprey captured at the facility to above the dam, releasing them at Little Goose Landing. In addition, to avoid exposure to sampling anesthesia, any adult Pacific lamprey found in the sample tanks were removed by USACE, ODFW, or Anchor QEA personnel prior to SMP sampling.

Table 22. Collection of incidental species at Little Goose Dam, 2017.

Common Name	Scientific Name	Expanded Sample	Separator	Total Collection [1]
American shad	*Alosa sapidissima*	108,868	27,946	136,814
Banded killifish	*Fundus diaphanus*	1	0	1
Bass—smallmouth	*Micropterus dolomieu*	8,757	220	8,977
Bass—largemouth	*M. salmoides*	5	0	5
Bullhead	*Ameiurus* sp.	1,260	3	1,263
Bull trout	*Salvelinus confluentus*	0	1	1
Channel catfish	*Ictalurus punctatus*	41	50	91
Chiselmouth	*Acrocheilus alutaceus*	1	2	3
Common carp	*Cyprinus carpio*	89	207	296
Crappie	*Pomoxis* sp.	7,732	31,046	38,778
Dace	*Rhinichthys* sp.	6	0	6

Kokanee	*Oncorhynchus nerka*	2	2	4
Lamprey Adult-Pacific	*Entosphenus tridentatus*	95	137[2]	232
Lamprey ammocoete-Pacific	*E. tridentatus*	5,156	1	5,157
Lamprey macropthalmia-Pacific	*E. tridentatus*	2,431	0	2,431
Mountain whitefish	*Prosopium williamsoni*	967	6	973
Northern pikeminnow	*Ptychocheilus oregonensis*	97	9	106
Peamouth	*Mylocheilus caurinus*	4,168	519	4,687
Rainbow trout	*O. mykiss*	11	14	25
Redside shiner	*Richardsonius balteatus*	0	0	0
Sand roller	*Percopsis transmontana*	481	78	559
Sculpin	*Cottus* sp.	199	0	199
Siberian Prawn	*Exopalaemon modestus*	31,668	0	31,668
Sucker	*Catostomus* sp.	954	271	1,225
Sunfish[3]	*Lepomis* sp.	1,158	24	1,182
Tadpole madtom	*Noturus gyrinus*	1	0	1
Walleye	*Stizostedion vitreum*	3	107	110
White sturgeon	*Acipenser transmontanus*	1	3	4
Yellow perch	*Perca flavescens*	0	77	77
Total		**174,152**	**60,723**	**234,875**

[1] Collection totals are estimated by expanding the sample counts, then adding the separator counts. Numbers include live and dead incidental fish.

[2] Number includes adult lamprey removed from the separator and from raceways.

[3] "Sunfish collection total includes 1,131 bluegill/pumpkinseed and 51 warmouth.

Table 23. Numbers of incidental species collected at Little Goose Dam JFF, 2012-2017.

Common Name	Scientific Name	2012	2013	2014	2015	2016	2017
American shad	*Alosa sapidissima*	14,614	6,678	1,799	5,634	157,259	136,814
Banded Killifish	*Fundus diaphanous*	61	117	111	53	0	1
Bass-Smallmouth	*Micropterus dolomieu*	2,442	1,279	3,528	2,102	2,992	8,977
Bass-Largemouth	*M. salmoides*	6	2	3	1	13	5
Bullhead	*Ameiurus* sp.	511	291	235	284	166	1,263
Bull trout	*Salvelinus confluentus*	2	6	4	0	10	1
Channel Catfish	*Ictalurus punctatus*	353	381	204	440	80	91
Chiselmouth	*Acrocheilus alutaceus*	2	6	10	7	19	3
Common carp	*Cyprinus carpio*	139	96	102	44	49	296
Crappie	*Pomoxis* sp.	687	1,139	887	9,407	3,135	38,778
Dace	*Rhinichthys* sp.	12	3	19	3	0	6
Goldfish	*Carassius auratus*	0	0	0	0	0	0
Kokanee	*Oncorhynchus nerka*	0	0	14	1	101	4
Lamprey Adult-Pacific	*Entosphenus tridentatus*	32	28	77	163	117	232
Lamprey Ammocoete-Pacific	*E. tridentatus*	1,903	525	2,495	89	1,592	5,157
Lamprey Macropthalmia-Pacific	*E. tridentatus*	4,749	55,077	18,673	8,155	33,631	2,431
Mountain Whitefish	*Prosopium williamsoni*	697	324	163	271	81	973
Northern Pikeminnow	*Ptychocheilus oregonensis*	52	41	43	32	29	106
Peamouth	*Mylocheilus caurinus*	1,077	1,292	864	1,230	512	4,687
Rainbow Trout	*O. mykiss*	2	0	8	27	2	25
Redside Shiner	*Richardsonius balteatus*	0	0	0	0	0	0
Sand Roller	*Percopsis transmontana*	2,452	6,241	3,681	1,603	294	559
Sculpin	*Cottus* sp.	1,732	1,239	391	1,836	633	199
Siberian Prawn	*Exopalaemon modestus*	23,183	45,015	81,310	464,586	51,518	31,668
Sucker	*Catostomus* sp.	882	1,353	1,062	1,631	504	1,225
Sunfish[1]	*Lepomis* sp.	602	865	791	263	501	1,182
Tadpole Madtom	*Noturus gyrinus*	8	8	3	4	3	1

Walleye	*Stizostedion vitreum*	7	9	14	27	65	110
White Sturgeon	*Acipenser transmontanus*	15	16	27	11	15	4
Yellow Perch	*Perca flavescens*	43	17	14	63	78	77
Other[2]	—	0	7	52	52	2	0
Total		**56,265**	**122,055**	**116,584**	**498,019**	**253,401**	**234,875**

Note- Numbers include expanded sample counts and separator releases
[1]Sunfish include bluegill/pumpkinseed and warmouth.

Research

ODFW and USACE personnel provide various types of research assistance during the fish passage season. Typically, ODFW provides research specimens that are collected on site via the sample. The summaries below describe each research or monitoring project that occurred at LGS in 2017.

Gas Bubble Trauma Monitoring

GBT monitoring was performed by Pacific States Marine Fisheries Commission biological technicians from LMN. When juvenile salmonid numbers permitted, a maximum of 100 fish were examined. Sampling occurred weekly from April 7 through August 21, 2017, when GBT monitoring was discontinued due to small sample sizes. Sampling was designed to determine the relative proportion of migrating juvenile salmonids passing the dam that exhibited symptoms of GBT in the unpaired fins and eyes.

A total of 1,993 smolts were handled by Pacific States Marine Fisheries Commission GBT personnel in 2017. Forty-two fish had been previously PIT-tagged and were enumerated and released without examination. A total number of 1,951 smolts were examined for GBT. Of those, 54.7% were subyearling Chinook salmon, 19.3% were yearling Chinook salmon, and 25.9% were steelhead smolts. Of those examined, 1.1% (21) showed signs of GBT. The total GBT mortality rate was 0.2% (2 yearling Chinook salmon and 1 subyearling Chinook salmon) of the 1,993 smolts handled.

Evaluation of Adult Pacific Lamprey Migration Behavior and Passage Success in the Lower Snake River.

This study used half-duplex (HD) PIT-tag systems to evaluate passage success of adult Pacific lamprey at McNary Dam, the four Lower Snake River projects and associated river segments. Adult Lamprey were captured and tagged at John Day Dam in 2014 and 2015, and tags remain active. This study will continue to require electrical power for electronics and access to maintain and download data from the PIT-tag detection equipment. Maintenance of equipment occurred during the winter maintenance period when adult fishways were dewatered.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for movement and behavior in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the

JFF. Further discussion of the PIT Tag System, including the Divert During Sample (DDS) system, can be found in the Facility Operations & Maintenance portion of this report.

Miscellaneous Monitoring

Juvenile Lamprey Monitoring

Beginning in 2011, all SMP sites were directed to report juvenile lamprey collections in more detail. Lamprey numbers are not included in the overall salmonid mortality data in this report, but have been added to the mortality tables for future years' comparisons (Tables 19 and 21). The lamprey ammocoete total mortality rate in 2017 was 0.3%, from a total collection count of 5,157 lamprey ammocoetes. The total mortality rate for Pacific lamprey macropthalmia this year was 0.3%, from a collection total number of 2,432 Pacific macropthalmia. No notable peak in total facility mortality for either life stage of juvenile lamprey was observed.

Mussel Monitoring

USACE personnel at the Little Goose JFF monitored the facility for both zebra mussel *Dreissena polymorpha* and quaggu mussel *Dreissena rostriformis bugensis* infestations. The mussel monitor is a piece of substrate suspended in the adult fish ladder near the ladder exit. There were no zebra or quaggu mussels observed during the 2017 season.

Turbine Strainers

USACE continued to monitor turbine unit strainers this year at LGS. Strainers are located in the piping associated with the cooling water intake valve for each of the six turbine units. Strainers were rotated and flushed weekly by USACE staff. Inspections took place at least once per month in accordance with the Fish Passage Plan. USACE staff inspected for any fish entrapment, particularly juvenile lamprey and results were reported monthly to the district office.

Avian Predation and Behavior

Avian activity was monitored and recorded at LGS by USACE and Anchor QEA. New bird protocols documenting bird behavior were established and implemented in 2012 and revised in 2014 by the USACE Fisheries Field Unit. One of the main goals of the avian data collection process is to standardize bird survey methodologies amongst the eight Federal Columbia River Power System hydro-projects. Collecting behavioral data will augment existing historical bird data and aid in bird hazing activities during the smolt outmigration.

Anchor QEA personnel conducted avian surveys daily from April 1 through November 2, 2017. Surveys were typically conducted between 1100 and 1400 during the juvenile fishway inspection. Only two specific bird behaviors were recorded this year—foraging and non-foraging—compared to the loafing/resting (on land or water), flyby, scavenging, and predating behaviors previously recorded. The survey list of piscivorous birds includes Caspian tern, double crested cormorant, and seagulls. American white pelican was removed from the survey list of piscivorous birds in 2015.

As in previous years, copies of the juvenile inspection form were forwarded to project USACE biologists. Survey results, along with the USACE survey results, were entered into a USACE database by USACE fishery personnel.

Juvenile Facility Operations & Maintenance

The juvenile fish bypass system was inspected at a minimum twice daily during the fish passage season. The juvenile bypass system and the collection facility were heavily impacted by debris, and some components such as the Vertical Barrier Screen failed making 2017 a challenging year for safe fish passage.

Forebay Debris/Trashracks

The surface area covered by debris and its location in the forebay was estimated daily by Anchor QEA personnel during juvenile bypass system and adult fishway inspections. In 2014, the trash sheer boom cable separated rendering the equipment ineffective, and it has not been repaired since. Consequently, this year all upriver debris passed through the project via spill, turbine intakes, or the juvenile collection system. Moderate to severe accumulations of woody debris averaging 21,307 square feet and ranging from 0 to 120,000 square feet were present in the forebay from April through June which caused various debris related issues within the juvenile collection system and likely contributed to the relatively higher mortality rate in 2017. Orifice blockages were frequent and numerous from April through June. Increased orifice rotation, and numerous separator cleanouts were all necessary to decrease debris accumulations within the juvenile collection system this year. Forebay debris decreased to minimal amounts after June averaging 1,600 square feet from July 1 through November 2.

Spillway Weir

The spillway weir (SW) was placed into operation on March 22 in the low crest (618 ft. msl) position. The spillway was placed into high crest position (622 ft. msl) on June 29. The spillway weir was removed from service for the 2017 season on July 19.

Turbine Operation

Efforts were made to operate all turbine units within 1% limitation of best efficiency from April 1 to October 31. There were numerous scheduled and unscheduled turbine unit outages during the fish passage season. Unit out of service (OOS) and return to service (RTS) dates, times and descriptions are listed in Table 24.

Table 24. Little Goose turbine unit outages, 2017.

Turbine Unit	Date OOS	Date RTS	Description
Unit 1	24-Jan 10:30	24-Jan 15:39	Dive Ops/FGE Removal
	14-Feb 07:05	14-Feb 10:40	Trash raking
	20-Mar 07:04	20-Mar 17:25	ESBS install
	20-Apr 16:05	20-Apr 19:45	Trash raking
	01-May 08:56	12-May 01:52	Trash raking
	16-May 12:18	16-May 16:55	Trash raking
	22-May 08:54	22-May 14:55	Trash raking
	31-May 07:10	31-May 10:15	Trash raking

	06-Jun 12:20	06-Jun 14:55	Trash raking
	19-Jun 07:21	19-Jun 10:03	Trash raking
	06-Jul 08:27	06-Jul 11:10	ESBS inspection
	11-Jul 00:41	11-Jul 06:35	Tripped on low gov. oil pressure
	11-Jul 07:05	11-Jul 10:10	Trash raking
	13-Jul 11:15	13-Jul 23:05	Pop off valve leaking
	21-Jul 20:43	22-Jul 15:16	Tripped on low gov. oil pressure
	07-Aug 07:03	07-Aug 08:30	Testing U6 as station service unit
	10-Aug 07:13	10-Aug 11:16	Testing U6 as station service unit
	15-Aug 06:43	17-Aug 10:50	Rewire GOP's 1, 2 and 3 controls
	12-Nov 08:21	15-Nov 13:27	T1 Doble testing
	27-Nov 07:15	04-Jan 14:53	Unit annual
Unit 2	24-Jan 10:30	24-Jan 15:39	Dive Ops/FGE Removal
	25-Jan 08:00	25-Jan 11:37	Dive
	14-Feb 09:45	14-Feb 13:00	Trash raking
	21-Mar 11:00	21-Mar 15:53	ESBS install
	20-Apr 13:30	20-Apr 17:00	Trash raking
	20-Apr 17:00	21-Apr 16:35	ESBS brush motor failure 2B
	02-May 09:40	17-May 15:10	Fish Screen Repair
	18-May 12:15	18-May 14:40	Trash raking
	22-May 09:00	22-May 16:30	Trash raking
	31-May 08:30	31-May 10:15	Trash raking
	06-Jun 10:02	06-Jun 14:55	Trash raking
	13-Jun 10:15	13-Jun 14:50	Trash raking
	19-Jun 10:07	19-Jun 15:03	Trash raking
	20-Jun 07:38	20-Jun 07:44	DC pump failed during plant switching
	12-Jul 07:11	12-Jul 12:25	Trash raking
	07-Aug 07:03	07-Aug 08:30	Testing U6 as station service unit
	10-Aug 07:13	10-Aug 11:16	Testing U6 as station service unit
	13-Nov 08:21	15-Nov 13:27	T1 Doble testing
	18-Dec 07:03	18-Dec 12:38	ESBS removal
Unit 3	24-Jan 10:30	24-Jan 15:39	Dive Ops/FGE Removal
	25-Jan 08:00	25-Jan 11:37	Dive
	14-Feb 10:45	14-Feb 14:05	Trash raking
	23-Mar 11:40	23-Mar 15:32	ESBS install
	03-Apr 06:53	03-Apr 10:07	ESBS/VBS Inspection
	03-Apr 10:57	03-Apr 16:14	Fish Screen Repair
	20-Apr 13:30	20-Apr 15:35	Trash raking
	05-May 08:30	13-May 10:56	Trash raking/VBS Repair
	18-May 08:00	18-May 14:30	Trash raking
	22-May 14:57	22-May 16:30	Trash raking
	05-Jun 14:48	05-Jun 16:30	Trash raking
	06-Jun 10:00	06-Jun 12:05	Trash raking
	13-Jun 10:15	13-Jun 14:50	Trash raking
	19-Jun 13:55	19-Jun 15:03	Trash raking
	12-Jul 07:12	12-Jul 12:25	Trash raking
	07-Aug 07:03	07-Aug 08:30	Testing U6 as station service unit
	10-Aug 07:13	10-Aug 11:16	Testing U6 as station service unit
	11-Sep 08:13	28-Sep 14:05	Unit annual
	13-Nov 08:21	15-Nov 13:27	T1 Doble testing
	27-Nov 16:59	05-Dec 06:42	Low turbine bearing oil level
	18-Dec 13:02	19-Dec 06:56	ESBS Removal

Unit 4	25-Jan 08:00	25-Jan 11:37	Dive
	14-Feb 13:05	14-Feb 15:42	Trash raking
	23-Mar 07:22	23-Mar 11:10	ESBS install
	03-Apr 10:13	03-Apr 11:10	ESBS/VBS Inspection
	04-Apr 09:02	04-Apr 11:54	ESBS/VBS Inspection
	14-Apr 20:38	15-Apr 11:36	Slip Ring Wipe Down
	12-May 07:08	18-May 07:11	Trash raking
	18-May 08:00	18-May 11:49	Trash raking
	25-May 09:20	25-May 10:47	ESBS inspection
	05-Jun 12:30	05-Jun 16:30	Trash raking
	07-Aug 07:03	07-Aug 08:30	Testing U6 as station service unit
	10-Aug 07:13	10-Aug 11:16	Testing U6 as station service unit
	14-Aug 07:50	06-Sep 06:52	Unit annual
	11-Sep 16:20	15-Sep 14:00	Vacuum breaker sticking open
	16-Oct 09:15	20-Oct 16:05	Packing Replacement
	13-Nov 08:21	15-Nov 13:27	T1 Doble testing
Unit 5	14-Feb 14:07	14-Feb 16:25	Trash raking
	22-Mar 09:05	22-Mar 14:10	ESBS install
	14-Apr 14:11	18-Apr 07:28	Excessive clearance on turbine guide bearing
	21-Apr 10:27	03-Sep 07:00	Excessive turbine guide bearing runout
Unit 6	14-Feb 15:41	14-Feb 16:31	Trash raking
	15-Feb 07:00	15-Feb 08:30	Trash raking
	21-Mar 07:21	21-Mar 10:40	ESBS install
	20-Apr 10:01	20-Apr 12:50	Trash raking
	17-May 07:46	17-May 08:54	Trash raking
	05-Jun 10:05	05-Jun 12:22	Trash raking
	20-Jun 09:17	21-Jun 15:17	Turbine pit flooded
	10-Jul 11:19	29-Jul 10:32	Unit annual
	29-Jul 10:50	01-Aug 13:45	Test unsat
	07-Aug 07:03	10-Aug 07:50	Testing U6 as station service unit
	19-Oct 07:00	19-Oct 17:30	Dive
	31-Oct 08:12	31-Oct 16:55	Mapping stilling basin
	01-Nov 07:05	01-Nov 14:45	Mapping stilling basin
	02-Nov 08:00	02-Nov 16:45	Mapping stilling basin
	03-Nov 07:00	03-Nov 13:00	Mapping stilling basin
	04-Nov 07:15	04-Nov 12:30	Mapping stilling basin
	05-Nov 06:40	05-Nov 17:00	Mapping stilling basin
	06-Nov 07:23	07-Nov 13:03	Mapping stilling basin
	13-Nov 08:21	13-Nov 15:26	T1 Doble testing
	15-Nov 09:58	15-Nov 13:27	T1 Doble testing
	11-Dec 08:00	13-Dec 04:58	Inspect Shear Beam Roller Assembly
	19-Dec 13:21	20-Dec 14:58	ESBS Removal

Extended-Length Submersible Bar Screens (ESBS)

All ESBS performed satisfactorily for the majority of the season. Fish screen 2B failed on April 20 due to a faulty cleaning brush motor. Fish screen 3B failed on May 13 and was repaired the same day. All screens were removed for the end of fish passage season during the week of December 12. Drawdown inspections across trashracks and ESBS/VBS were performed according to the FPP. A drawdown inspection conducted on April 16 found Unit 1 out of

criteria. All other inspections were measured within criteria throughout the season. Video inspections and manual operation inspections showed all screens in good operating condition.

Vertical Barrier Screens (VBS)

Inspections of all VBS were performed by underwater video camera per FPP requirements. Underwater camera inspections occurred on April 03 and 04 for Units 3 and 4, respectively. Underwater inspections also occurred on June 19 for Units 1 and 2. Additional inspections were conducted during Unit annual maintenance. Inspections found failed or worn VBS in slots 1A, 1B, 2A, 3B and 6A. Worn screens were repaired or replaced. Screens will continue to be replaced with new during Unit annual maintenance.

Gatewells

Gatewells were checked for debris and oil contamination daily. As needed, debris was removed using a dip basket or grappling hook. In 2017, the occasional oil films were observed on the water surface in several gatewells similar to previous years. Some oil films appeared to be petroleum based and may have been produced, in part, from rain-washed oil/grease residue associated with mechanical equipment and vehicles.

Orifices and Collection Channel

The collection channel was operated throughout the season with 18 to 22 open orifices depending on forebay elevations. Orifices were inspected and/or back-flushed two to five times per day. All orifice operations were manually performed throughout the year.

The collection channel was dewatered and removed from service on December 20. Fish salvage operations during the dewatering included releasing approximately 75 adult steelhead and 25 juvenile lamprey back to the river.

Primary Dewaterer/Primary Bypass Pipe

The primary dewatering structure and components functioned adequately throughout the season. Inspection of the primary dewaterer and manual operation of the cleaning brushes was performed twice daily. As in past years, the excess water was diverted to the adult fish channel pump chamber throughout the season to improve adult fish attraction and migration.

Bypass Flume/Pipe

The primary bypass flume functioned satisfactorily in 2017. During winter maintenance 2010, the flume outfall was relocated from near shore to mid channel. The relocation extended the release site approximately 400 feet north into the river mid-channel. This new section of outfall is made of 36 inch corrugated metal pipe. The new point of release returns bypassed fish farther from the shoreline and in an area of higher velocity to reduce exposure to piscivorous predation. The flume was inspected during the winter maintenance period and observed in overall good condition and found free of obstructions and rough edges.

Separator

The separator was operated similar to previous years. The water level was kept about one to two inches above the downstream end of the B-side separator bars. During the winter maintenance period, the interior and exterior surfaces of the separator were cleaned and refurbished. There were three separator debris removal events in 2017. On April 20, May 22 and June 14, fish were routed to the river and debris was removed from the separator.

Sample System/PIT Tag System

The PIT tag detection and diversion systems at the lower Snake and Columbia River dams are maintained and operated by the Pacific States Marine Fisheries Commission. PIT tagged salmonids have been monitored for migration in the Columbia and Snake rivers since 1987. At Little Goose Dam, there are 11 PIT tag monitors located throughout the JFF.

In previous years, the state of the Divert During Sample (DDS) system was manually changed by USACE project biologists and technicians based upon fish passage and sample rates. However, in 2012, the DDS system was upgraded during the winter maintenance period to allow for automatic changes of operational mode per entry of the sample rate. However, the system still retains the ability to override the automation and change the system manually.

At low sample rates ($\leq$20%), when large numbers of fish are passing through the system, the DDS setting is deactivated. When the DDS is deactivated, the PIT tag slide gate will not open when the sampling system is engaged. This setting helps avoid potential sample bias caused by diverting large numbers of untagged fish, along with the targeted PIT tagged fish, away from the sample during a sampling event. At sample rates greater than or equal to 20%, (low numbers of fish passing through system), the potential for sample bias is lower and the DDS system is set to "On" or activated.

DDS settings for the A and B side sample tanks followed recommendations for most of the season. Minute deviations (hundredths of a second) typically occur daily at approximately 0700 as a result of equipment operation as the facility prepares for a new 24 hour sampling period. In addition, deviations from the recommended settings occur when debris removal is conducted at the separator. During a separator clean out, large volumes of fish and debris are flushed from the separator and thus it becomes essential to turn the DDS off. Three separator clean outs were conducted this year.

Pit Tag Detections

The Passive Integrated Transponder (PIT) tag detection system records data on PIT tagged salmonids as they pass through the juvenile collection system. The PTAGIS database categorized all PIT tag detections based upon species, race, and clip/rearing type. An additional "orphan" category was used for detections of PIT tags for which the database contained no record of tagging and release. Fish dispositions were categorized based upon exit monitor detections: 1) to the river, 2) to transport holding areas, 3) to the smolt monitoring sample, and 4) unknown. This last category included final detections of PIT tagged fish at locations that did not constitute an exit from the facility.

From April 1 through November 1, 2017, a total of 115,919 PIT-tagged fish were detected within the juvenile collection/bypass system: 66,123 Chinook salmon, 47,990 steelhead,

759 sockeye salmon, 714 coho salmon, and 333 orphans of unknown species/rearing type. Of the total number of detections, 82.3%, or 95,411 fish, were routed to the river, and 17.7%, or 20,508 fish, were routed to transport areas. PIT-tagged fish in the subsample were treated as the other fish in the sample and were either routed back to the river, if the facility was operating in secondary bypass mode, or routed to a transport holding area when the facility was operating in collection mode. Approximately 0.6% of the PIT-tagged fish detected at LGS, or 662 PIT-tagged smolts, were routed to the sample this year; 80.7% (534) were transported and 19.3% (128) were returned to the river during pre-transport operations and when in secondary bypass (April 1 to 30, July 20 to 25, and September 6 to 20). Prior to the start of the transportation season, all PIT-tagged fish were routed back to the river. Approximately 64.4%, or 74,611, of the total PIT-tagged fish detected were detected prior to the start of collection for transportation.

Avian Predation Deterrence

USDA Animal and Plant Health Inspection Service (APHIS) began bird hazing activities in 1999. In 2017, APHIS bird hazing activities at Little Goose took place from April 4 through June 26. The hazing schedule included 8 hours per day, 7 days per week of land based hazing and 8 hours per day, 3 days a week of boat based hazing from April 03 through June 23. Additionally, a second 8 hour per day shift was conducted from April 21 through June 01. Bird hazing took place in the areas of the juvenile bypass outfall, spillway and powerhouse discharge areas, and areas where birds congregate or feed, ranging from about 2,000 feet upstream of the dam to as much as 1 mile downstream of the dam.

USACE Biologists and personnel from Anchor QEA conducted bird counts extending from the immediate tailrace and forebay to approximately one half mile upstream and downstream of Little Goose Dam and were broken into two zones; tailrace (T1) and forebay (FB1). Counts were conducted using binoculars 2 to 3 times daily from April 1 through October 31, 2017. Bird counts also monitored foraging and non-foraging activities of gulls, cormorants and terns. Maximum daily bird counts were utilized to tabulate weekly and annual reporting.

Avian counts reached and exceeded the maximum thresholds allowed per the Fish Passage Plan multiple times throughout the season. Gull counts exceeded the 100 bird threshold 13 times throughout the bird counting season, April through October. Of these occurrences, gulls exceeded the threshold 7 times while APHIS personnel were actively hazing and 6 times while APHIS personnel were offsite, or outside the scope of the hazing contract. Cormorant counts exceeded the 50 bird threshold 1 time throughout the bird counting season, which occurred in October. Lethal take was implemented with 59 gulls and 2 cormorants were sacrificed during the 2017 season. Additional hazing by project personnel utilized bird scare products including propane scare cannons, bird bangers and bird screamers deployed intermittently throughout the remainder of the fish passage season. The water cannon located at the bypass outfall was used continuously throughout the season. Little Goose continued to use passive bird deterrent devices to include needle strips, bird wires and visual scare devices.

Gull Counts

The maximum total daily number of 219 gulls counted occurred on October 23. The average daily total count was 32 gulls. The maximum daily count in the forebay was 217 gulls and occurred on October 23 with a daily average of 25 gulls. The maximum daily count in the tailrace was 84 gulls and occurred on May 04 with a daily average of 7 gulls.

Double Crested Cormorant Counts

The maximum total daily number of 57 cormorants occurred on October 26. The average daily total count was 9.0 cormorants. The maximum daily count in the forebay was 52 cormorants and occurred on October 26 with a daily average of 8 cormorants. The maximum daily count in the tailrace was 34 cormorants and occurred on October 15 with a daily average of 1 cormorant.

Caspian Tern Counts

The maximum total daily number of 2 terns occurred on July 07, 10 and 23. The average daily total count was 0 terns. The maximum daily count in the forebay was 2 terns and occurred on July 10 with a daily average of 0 terns. The maximum daily count in the tailrace was 2 terns and occurred on July 07 and July 23 with a daily average of 0 terns.

Other Piscivorous Bird Counts

The maximum total daily number of 32 grebes occurred on October 13. The average daily total count was 0 grebes. The maximum total daily number of 17 pelicans occurred on May 01. The average daily total count was 0 pelicans.

Avian Foraging Behavior

Foraging behavior was monitored and recorded for gulls, cormorants and Caspian terns. Caspian terns had the highest overall percent of observed foraging behavior (28.6%) followed by gulls (21.0%) and cormorants (15.0%). Gulls had the highest percent of feeding behavior in the tailrace (70.4%) followed by cormorants (68.4%). Cormorants had the highest percent of feeding behavior in the forebay (8.3%) followed by gulls (7.9%). Caspian terns were only observed four times at Little Goose and were only observed feeding in the tailrace. The majority of all avian foraging occurs in the tailrace with resting, loafing and perching occurring in the forebay.

Facility Modifications

Several modifications and repairs were made prior to, during and after the 2017 season.

1. Adjusted the 36” butterfly valve in valve box B.
2. Repaired and replaced PIT tag gate components per requirements.
3. Repaired PIT tag pipe hangers.
4. Replace barge loading hose.
5. Repaired separator and resurfaced and painted various sections.
6. Repaired/replaced multiple ESBS screen cleaning motors.
7. Replaced foam between incline screen sections in the primary dewatering structure.

Juvenile Facility Recommendations

1. Continue to write revisions and updates to the operations maintenance manual pertaining to new equipment and facility collection and transport procedures
2. Repair the trash/shear boom.
3. Continue to rebuild orifice valve cylinders.

4. Repair or replace corroded outer steel orifice pipe with stainless steel.
5. Review protocols yearly to ensure effective communication between all parties during truck/barge loading, dewatering events, separator cleanouts, etc. This will ensure that fish are properly routed, flush water is available for fish transfer, and that there is sufficient water in holding tanks
6. Continue to remove scale and rough edges in the facility flumes, tanks, and transition areas.

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